DOCUMENT RESUME

ED 316 183 IR 014 142

AUTHOR	Collins, J. H., Ed.; And Others
TITLE	Proceedings of the International Conference on Technology and Education (6th, Orlando, Florida, March 1989). Volume 1.
SPONS AGENCY	Tandy Corp., Ft. Worth, TX. Radio Shack Education Div.
REPORT NO	ISBN-0-905941-30-6
PUB DATE	Mar 89
NOTE	591p.; For Volume 2, see IR 014 143; for the proceedings of the fifth conference, see IR 014 140-141.
PUB TYPE	Collected Works - Conference Proceedings (021) -- Reports - Descriptive (141) -- Reports - Research/Technical (143)
EDRS PRICE	MF03/PC24 Plus Postage.
DESCRIPTORS	*Administration; *Artificial Intelligence; *Computer Assisted Instruction; *Distance Education; *Educational Technology; Elementary Secondary Education; Higher Education; Interactive Video; Leadership; Open Education; *Teacher Education; Technology Transfer; Telecommunications

ABSTRACT

The first of two volumes in these proceedings contains the text (or, in a few cases, an abstract) of 60 papers on the use of technology at all levels of education, including elementary, secondary, and higher education. These papers were presented in 44 topic sessions by delegates representing more than 30 nations. Themes of the sessions include: (1) educational administration and leadership; (2) enabling technologies; (3) higher education; (4) using computers to enhance instruction; (5) artificial intelligence; (6) open and distance learning; (7) teacher education; and (8) futures. An alphabetical list of authors for this volume is provided. (GL)

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The Sixth International Conference on Technology and Education

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The Sixth International Conference on Technology and Education

Volume 1

Orlando, Florida – March 1989

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Published by CEP Consultants Ltd, 26–28 Albany Street, Edinburgh EH1 3QH, UK
Printed in Great Britain by Page Bros (Norwich) Ltd.

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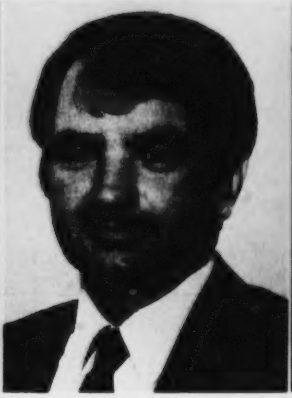
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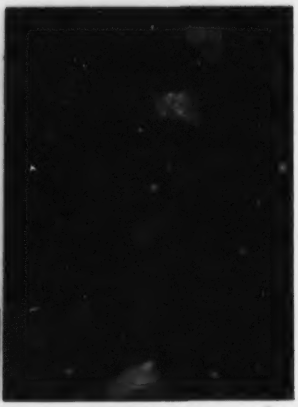
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FOREWORD

In our Introduction to the Proceedings for the 1988 Conference held in Edinburgh, we stress the serious challenge faced by society in coping with the complexity of world problems and the capacity of people to solve them, as we race towards the twenty-first century. Education is required, as never before, to prepare the youth and leaders of tomorrow to develop the full potential of their human resource. Fortunately, we are at the full dawning of the information age with its embodiment of sophisticated technology, which can facilitate people to become knowledge rich and make the intelligent decisions that are necessary for the society of today.

The Sixth International Conference on Technology and Education (ICTE) here in Orlando, builds on the momentum established at Edinburgh by delegates from more than 30 nations. Our hosting co-sponsors from the State of Florida, a leader in applying technology to education, left no stone unturned in supporting the International Organising Committee particularly in terms of the pre-Conference field visits and all the local arrangements.

The technical program has been greatly expanded in keynote addresses, contributed papers, panel and poster sessions and the many "hands on" workshops. The power of technology in facilitating international exchanges amongst educators is very evident here in Orlando through the NASA Satellite Video Conference on "Technology in the Classroom" and the report on the WorldLink project of 120 schools dialogueing around the globe by electronic mail. We are deeply indebted to McGraw Hill, Tandy Corporation and Software Publishing Corporation for making this possible.

This year, MicroSoft joins Tandy and InterTan as a corporate sponsor of the conference. We are delighted that many educational and software publishers as well as hardware vendors and educational institutions are present in the Exhibition Hall.

These Conference Proceedings truly cover all aspects and levels of education from primary to higher education emphasising the ever growing role of technology in unifying these through the classroom and educational administration and leadership to more efficiently develop the human resource.

The Conference and these Proceedings bear testimony to a tremendous commitment of time and energy by those who have worked on the organising and planning of the Sixth ICTE. We wish to express our appreciation for the support and expertise extended by the following individuals:—

James Schott, Orange County Public Schools, Orlando, USA
Richard Cornell, University of Central Florida, USA
David Brittain, Florida State Department of Education, USA
Ron Hurley, CEP Consultants Ltd, UK

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HOW TO INTRODUCE COMPUTERS IN EDUCATION -THE SWEDISH EXPERIENCE

BENGT BENGTSSON *

ABSTRACT

The leading principle is to transform the school from a school of facts - a data school -to a knowledge based school. Them Ministry of Education has formed a strategy, based on a process of changes via research, experimental activities, a continuous evaluation and integration. During this work we tried to look at the school as a system considering all the necessary components to create good educational surroundings and effect by using computers. This paper describes the results from a group within the Ministry of Education that has formed an action program for computer science education in school, adult education and teacher training and from The Educational Software Group within the Ministry that has recently presented its final report to the government.

INTRODUCTION

In Sweden children start school at the age of seven. After nine years of compulsory education, practically all children go through high school or the "gymnasium". Computers are rapidly introduced in a number of subjects and high school lines. Computers are used for some partly overlapping purposes: - to provide the students with a general knowledge and prepare them for the society in which they are to work.- to prepare them for a computerized working life,- to make teaching of many school subjects more interesting. It is important to realize that the use of computers is seen as a creative complement to the normal work of the teachers and is in no way intended to replace it. This means that conventional computer-aided teaching is not a central factor in Swedish schools. In a small country like Sweden central backing is absolutely essential to afford all the hardware, software, teaching aids, in-service-training and so on that are needed if computers are to be used effectively in schools.

EDUCATIONAL FIELDS

The varying purposes of computer science instruction are bound to influence the choice of teaching method and equipment in the form of computers and software. For this reason we have divided the uses of computers in school into the following educational fields.

COMPUTER LITERACY

Every students is entitled to a course of 80 lessons in computer literacy, integrated with other subjects aimed at giving general competence and to illustrate the impact on society and on human beings of a computerized society. Computer literacy is introduced at the senior level of compulsory school and in the first grades of upper secondary school. All adults also have an opportunity to receive broad-based foundation training in computer literacy.

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VOCATIONAL TRAINING

At upper secondary school there are many different educational programs aiming towards future professions or further studies at the university level. Their purpose is to reflect the use of computers in different occupations. This instruction is designed to confer up-to-date skills through use of modern hardware and software. In view of the rapid pace of technical progress and the extensive changes this is producing in occupational activities, heavy new investments are presently being done in equipment and educational measures especially for upper secondary schools and in in-service vocational training.

COMPUTER SCIENCE

In this field computers are used in the education of future computer experts. These students are trained in various information technology subjects to become systems analysts. programmers and other specialists within computer sciences. Instruction is provided in upper secondary schools, in certain upper secondary school advance study programs and in special vocational programs. In upper secondary schools information technology has also come to be widely studied by students taking natural science and technology lines.

COMPUTER-ASSISTED TEACHING

In this activity the aim is to use the computer as a pedagogical tool to enhance the quality of education and augment the potentialities of teaching. The computer itself is just a supplier of pedagogical ideas. Computer assisted teaching is not officially approved of in Sweden. During the next three years the government has proposed experimental activities to be conducted in all types of school and on all levels of compulsory school, upper secondary school and adult education. A great deal of research is presently being done in the problems of pedagogics and methods in this field. The general idea is to use the computer as a teaching aid only when it is expected to expand the scope of teaching or to improve its quality.

COMPUTER TECHNOLOGY IN SPECIAL TRAINING

Handicapped students are offered computers as a mean of offsetting disabilities and preventing further future disadvantages. This is an important field for educational development now and in the future in Sweden.

SOFTWARE FOR THE DIFFERENT ACTIVITIES

Software is usually divided into a number of categories, supporting the different educational fields: - general tools or open-ended programs that can be used for all educational fields, -subject-oriented tools aimed at certain professions, -subject-oriented tools for different school subjects, -lessonware or courseware ranging from drill and practice to programs for advanced simulations.

The division into educational fields and the division of software is not absolutely strict. When characterizing education the point of departure should be its purpose not the equipment and software chosen.

SOFTWARE FOR COMPUTER LITERACY

In computer literacy courses the schools us open-ended software to demonstrate the use of computers in society. The aim is not to master the tools but only acquire an introduction. The software packages used have been simplified and adapted to the educational needs and integrated with effective teaching material. Students use the word processor to write essays and reports. With the help of spreadsheets they can manipulate figures etc With data base handling they learn how to collect and compile data to information

In short, general software tools are suitable for teaching students how to collect, treat and present information. Software for data-communication and software packages for graphics are also part of the program library for education in computer literacy in Sweden.

SOFTWARE FOR VOCATIONAL TRAINING

An important task of vocational education is to introduce computer technology as an integrated component of the vocational subjects. For all these different educational programs the use of open-ended and subject-oriented software tools is a natural option. Software from industry may sometimes fall short of school requirements and must be adapted to the demands of the schools. Most of todays software tools however are very user-friendly and they are constantly developed. The National Board of Education regularly tests and evaluates a number of programs to determine the extent to which they meet the stipulated standard in our schools.

SOFTWARE FOR COMPUTER SCIENCE

The aim here is to teach students systems analysis, programming and other computer subjects. There is no urgent need for specially designed software in this area.

The third generation of programming languages, 4GL-tools and knowledge-based languages such as Prolog are included in the curriculum as well as knowledge of expert-systems and CASE-tools.

SOFTWARE FOR COMPUTER-ASSISTED TEACHING

If a school has computers and open-ended software for its teaching in computer literacy it is logical that the teachers will also try to use these programs entirely for educational purposes in their own subjects. Word processing, spreadsheets and database handling can be used to help students to put together, evaluate and present data. Software for data-communication give students access to national and international data bases where they find information. Packages for graphics can be used to illustrate reports in various school subjects. Schools also need subject-oriented software-tools specifically designed for them and a large number of lessonware and courseware in order to learn a certain subject. Lessonware has many form from programs for simple drill and practice to programs for training and simulation. Within Scandinavia a great many programs have been developed with support from the state and by the Educational Software Group.

SOFTWARE FOR STUDENTS WITH SPECIAL NEEDS

These students not only need specially designed software but a great many special devices and peripherals such as keyboards, enlarged text, sound etc to reduce or eliminate the difficulties they experience in education. In close cooperation with the National Swedish Board For Technical Development we have started a large project, supported by the Swedish authorities designed to produce, test and evaluate both hardware and software as a personal and educational aid.

OTHER RESOURCES NECESSARY

To concentrate attention on the educational uses of computers and software it is necessary to create effective resources to support municipalities, schools and teachers. Special resources are necessary to support the development of software, teaching material, in- service training and research. In Sweden we are building regional resource centers and each school has a local coordinator to administer the computer systems , recommend new acquisitions and promote the development of methods and pedagogics in the school.

HARDWARE

Most Swedish schools have a computer laboratory subsidized by the state with approximately 8 to 16 or often more workstations. The workstations are connected in a local area network. The computer mostly used was developed within a project initiated in 1981 when the Swedish government commissioned the National Swedish Board for Technical Development to develop computer hardware and software for Swedish high schools. The project resulted in a school computer COMPIS (Computer In School). The project also resulted in a substantial amount of pedagogical software and equipment for different school activities. The newest product uses the Intel 80286 processor and is fully IBM-compatible. The Board of Education has a yearly evaluation of new products which will be subsidized by the state.

IN-SERVICE TRAINING.

The authorities presently make considerable efforts in training teachers for the different computer activities giving courses in computer literacy, activity-oriented courses, present tutorial packages for teachers and so on. Approximately 25 % of the total cost for in-service training of teachers in Sweden goes to computer-courses.

CONCLUSION

When schools invest in computers it is important to adapt an overall view and strategy and to estimate the total cost. If the many components needed to produce the desired educational and administrative effects are given proper consideration, cost-components in the system can easily be overlooked. An extensive use of computers in education might gradually effect the future organization of schools, the division of subjects, the teacher's and the student's role and demand a new methodology, education and pedagogy, We do not intend to computerize an old-fashioned behavior.

IMPLEMENTATION OF DISTRIBUTED COMPUTING STRATEGY IN A LARGE SECONDARY SCHOOL DISTRICT

Dr. J.M.Doyle*, J.Rayburn*, V.K.Dutta**

ABSTRACT

A secondary school district may have many small, medium and large schools dispersed over a metropolitan or rural area and each institution may require access to information on the school district's central computer as well as information which may be local to that institution. Schools also need to interact with each other in order to exchange information. Clearly, a strategy which allows mainframe computers at the central district site to connect to local computers at school sites needs to be developed. In this strategy computing resources are provided in classrooms(Microcomputers), at schools(Minicomputers), and the central district site(Mainframe Computers). Computing resources within a site are connected over a local area network(LAN), and LANs are connected over extended local area network(ELAN) using wide area network technology. Products conforming to International Standards Organization/Open Systems Interconnect(ISO/OSI) model are used to allow complete openness and flexibility of interconnection of products from many vendors. Thorough planning, professional installation, adequate training, and access to sophisticated network management products are essential for a successful implementation of this strategy.

INTRODUCTION

One of the many challenges facing educators at the secondary school level is to plan and implement a computing strategy which not only provides appropriate computing resources to students, teachers, counselors, principals, administrators and others, but allows hands-on access to those resources necessary to becoming computer literate and promotes active use of information for greater academic enrichment and better managerial and administrative controls. Traditionally, secondary schools have used mainframe computers for administrative computing and microcomputers for classroom instructions. As demand for access to information has increased, school districts have found themselves faced with expensive upgrades of their mainframe computers. Mainframes isolate end-users from true interaction with computers. Microcomputers, on the other hand, make it difficult to interchange information among users. One aspect of the distributed computing strategy deals with how to connect microcomputers and mainframe in one seamless system, the other aspect deals with defining applications which are best suited to remain on the mainframe and applications which should migrate down to the end-user's microcomputer or a school-based minicomputer. A careful analysis of current and future business, administrative, and instructional data processing requirements provides the information needed to size mainframe and minicomputers and the network which is going to connect them to microcomputers. School district's central data processing organization plays a key role in implementation of this strategy by providing technical support in planning, installation, and operation of the network.

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The Sweetwater Union High School District is the largest Secondary District in the state of California. The district has more than 20 schools and it serves approximately 27,000 students in grades 7-12. In 1987 the district undertook a study to determine requirements for administrative and instructional data processing. The district built a model for data processing which will allow it to provide computing resources in a centralized and decentralized(distributed) manner to best serve the end-users by providing them appropriate resources and direct interaction and control over the resources. The data processing model has two components: Computation Model and Network Model.

COMPUTATION MODEL

The computation model defines three levels of data processing and functions performed at each level. The three levels are: desktop, school, and central district site. Functions at each level are designed to support applications that are best suited for that level. Applications can be from stand-alone to district-wide. The three functions defined by the model are client services for desktop devices, server functions for desktop devices, and mainframe functions for desktop devices and district-wide applications. The client services present an easy-to-use interface to an end-user and insulates the end-user from the complexities of accessing services at school and the central district site. The next level of function provides server-based services(print, file, disk and application) for desktop devices. The third level of functions is provided at the central district site where mainframe resources are available for district-wide applications and routine but critical operations such as: backup and restore of school server data files, troubleshooting, system management, physical system security, and network security. (See Fig. 1 for Computation Model).

It is quite clear that the model cannot provide all functions unless there is a strong network connecting devices at desktop to schools and schools to the central district site. Therefore, a network model was developed.

NETWORK MODEL

The network model has two components. The first component defines the physical connection scheme for connecting devices in a local area network and the second component defines many standard software features of an ISO/OSI compliant network (see Fig. 2). In addition to the standard features, the model defines many desirable features, such as: network installation tools, network management tools, remote system management, electronic mail, industry standard client-server software for desktop devices, network conferencing, bulletin boards, and related applications.

PLANNING AND DESIGN

Ethernet was selected to provide physical and data link level connection between devices at school sites and the central district site. Each school and the central district site is wired for Ethernet and will have faceplates to allow easy attachment of desktop devices to the network. Ethernet-based terminal servers are used to connect printers, terminals, and modems. School-based computers connect directly to Ethernet. Ethernet-based bridges are used to connect each school's Ethernet to Ethernet at the central district site. Bridges use 56kbps lines to provide extended Ethernet between schools and the central district site.

Bridges used in this implementation are protocol independent and have the capability to prevent local traffic from reaching the extended Ethernet. In this configuration, desktop devices in any school have access to services offered by the server in their school and services offered by servers at other schools and the central mainframe. Each school has the flexibility to add more services and desktop devices without affecting any other school or the central district site. The network manager controls access to inter-school services and services at the central district site. The entire network was thoroughly planned and designed prior to installation. A network implementation team was formed to coordinate physical installation of the network and to quickly resolve any issues related to physical design or installation of the network. (See Fig. 3 for Overview of the Network).

TRAINING

Four levels of training are required. An end-user who is only using a terminal to access a local or central application needs first level of training which trains the end-user to sign-on to the system offering the application and how to use the application. End-users who are using a desktop computer (PC or Mac) require the second level of training. These end-users require thorough training in using their desktop computers and using file, disk, print, and application services offered by their local server and the central mainframe. All end-users need to be trained in using network-based applications, such as: electronic mail, network conferencing, bulletin boards, and similar applications. End-users with desktop computers also need to be trained in basic troubleshooting of their computers and network devices. The third level of training is required at the school level where the principal and the school secretary are trained to become local system managers for the server in the school. Most of the major system management functions for the school based server are to be performed by the central site system manager. Therefore, training in only elementary system management tasks is required at this level. The principal and the school secretary work with the network manager to install the server in the school and select applications and services to be offered on the server. The fourth level of training is required at the central site where the system manager and the network manager need to be fully trained in remote system management, network installation and management tools, network troubleshooting, and a thorough understanding of different technologies that are used in building an extended local area network.

SUMMARY

A distributed computing strategy allows placement of computing resources where the end-users reside. The extended local area network provides the technology that binds distributed resources into one seamless network for the end-user. Careful planning and design are required to build a network which allows end-users to have access to services without network and system management chores. Adequate training of end-users at all levels is essential for proper utilization of computing resources.

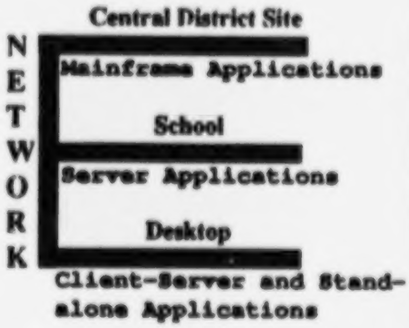
Central District Site
N
E
T
W
O
R
K
Mainframe Applications
School
Server Applications
Desktop
Client-Server and Stand-alone Applications

Fig.1 The Three Level Computation Model

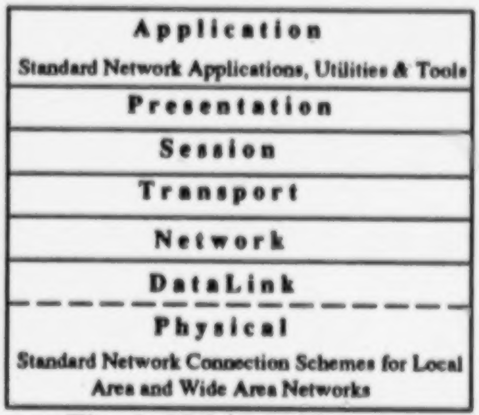
Application
Standard Network Applications, Utilities & Tools
Presentation
Session
Transport
Network
DataLink
Physical
Standard Network Connection Schemes for Local Area and Wide Area Networks

Fig. 2 ISO/OSI Based Network Model

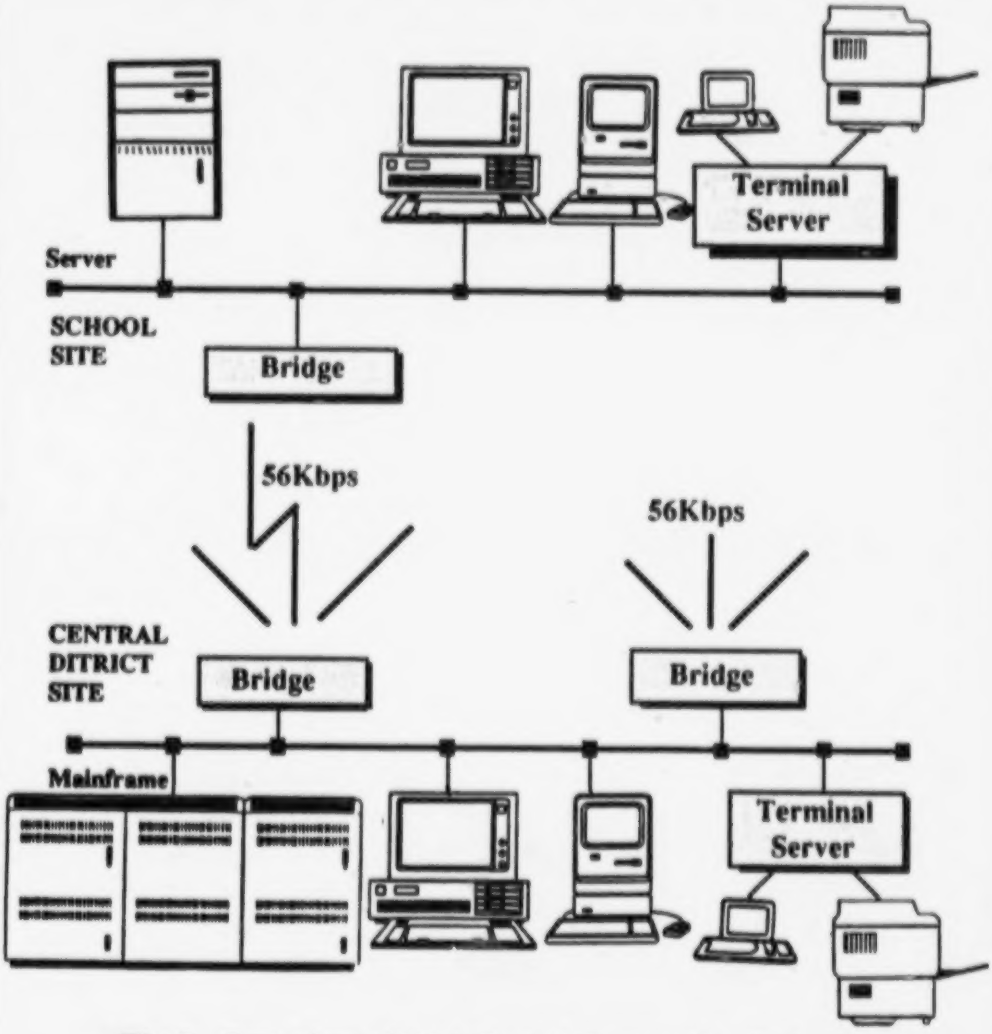
Terminal Server
Server
SCHOOL SITE
Bridge
56Kbps
56Kbps
CENTRAL DITRICT SITE
Bridge
Bridge
Mainframe
Terminal Server

Fig 3. Overview of Distributed Computing Network

INTEGRATING COMPUTER TECHNOLOGY INTO COMPUTER STUDIES

Tim Crawford*

ABSTRACT

This paper outlines the way in which secondary school computer studies courses were re-designed so that advanced level students as well as average level students received at least some introduction to computer technology and computer electronics. A unit of electronic concepts was added to the introductory course. The computer science course which followed, had injected into it: number systems; Boolean algebra; logic gates; and computer circuitry. As a result, students going on in technology received a better mathematics background and an understanding of how mathematics is used in designing a computer. Those students going on in computer science had a much better background knowledge in what is inside the computer and how it functioned.

INTRODUCTION

From about 1970 to 1983 the computer curriculum for Ontario secondary schools was made up of 4 documents. One addressed the need for a computer awareness or computer literacy course. It was aimed at the grade 10 level. The three other curriculum documents described courses for grades 11 and 12: data processing, computer science and computer technology. The data processing and the technology curriculum enabled courses to be designed for the above average student as well as the average. The computer science curriculum was designed solely for the above average student.

Analysis of the whole program in 1980 identified weakness and strengths in the documents. In addition, considerable input received from the field indicated what was evolving in the classroom and what leading teachers were accomplishing with the microcomputers.

Highlights of all input which related to technology were as follows:

- those taking the technology courses seemed to have too light a background in mathematics
- some teachers were introducing some technology components in the introductory course with considerable success
- there seemed to be no synthesis of the programming courses with the technology curriculum.

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After wide consultation with teachers in the field, the Ontario Ministry of Education developed a comprehensive curriculum outline to address these problems, as well as bring the curriculum up-to-date. The goal was to provide as many students as possible with an introduction to electronics and technology (above average students as well as average students). A unit on computer circuitry was to be part of the introductory awareness course. In addition to providing some awareness, it also helped to identify latent interest or abilities in technology in some of the average and above average students. A major unit on number systems, Boolean algebra and circuitry was to be included in the computer science course--which was formally almost solely programming.

In addition, it was deemed necessary to provide students who were taking mainly technical courses with a better mathematics background so that they could better handle the senior computer technology courses.

THE INTRODUCTORY COURSE

The grade 10 introductory course was re-designed to include an overview of the hardware and how it works, as well as an introduction to computer electronics. Students who would traditionally be taking purely academic subjects were exposed to logic gates, flip-flops, busses, ports, registers and integrated circuits. (Other components of the course are listed in the accompanying chart.)

One of the highlights of the course for the author is presentation of the 'major project' by each student or pairs of students. A significant number of students select a project based on the technology or electronic curriculum units. Their creativity certainly impresses colleagues and teachers in both the technical department of our composite school and the computer science department!

COMPUTER SCIENCE AND TECHNOLOGY

When committees were formed to actually write the curriculum for the senior courses it was found that some computer science teachers had difficulty identifying just what computer science was! A number of them perceived it to be programming, period. Some of the leading computer science teachers in the province were introducing other topics such as hardware architecture along with the programming.

A rationale was provided that computer science should include at least an awareness of the architecture and the nature of the activity which took place inside the computer. It took some time for teachers to accept these notions.

Subsequently it was proposed that the grade 11 computer science curriculum include a unit which would build on the introduction to computer circuitry taught in the grade 10 course. When it was suggested that the math/computer science teachers include a unit on 'number systems used in the computer and Boolean logic' there was ready agreement. It was a short step to move from these topics to computer circuitry, and simple circuit design.

There was considerable resistance, however, to this by a significant number of teachers. It was later discovered that the resistance was mainly due to the lack of perception as to how all this could be synthesized. Some workshops on the synthesizing process uncovered another problem. Some well qualified mathematics teachers had missed taking Boolean algebra in courses they had taken at university. Not only was it necessary to teach the conventions for representing logic gates, but it was necessary to 'review' Boolean algebra. Once reviewed, the teachers were able to synthesize number systems, Boolean concepts and logic gates. Software was developed to enable students and teachers to explore the design of circuits in an interactive environment. Kits were provided so that students could experiment with actual integrated circuits.

THE EMPHASIS ON 'COMPUTER MATH' PAYS OFF

Students who were successful in the new computer science and technology course had excellent background to go on to either advance programming and problem-solving, and/or, the very technical advanced level course in 'interfacing'. They had by the end of the grade 11 course a stronger mathematics background (which was one of the goals established for the re-design of the courses) and they have a good background in programming.

The grade 12 computer science course encouraged the teaching of some additional technology concepts but essentially remained a programming course.

As a result there seems to be an increased number of our students going into the field of computer science and computer technology. At the very least, our graduates are better rounded and can 'hold there own' when talking to people with special knowledge of the function of the computer.

THE COMPUTER TECHNOLOGY COURSES

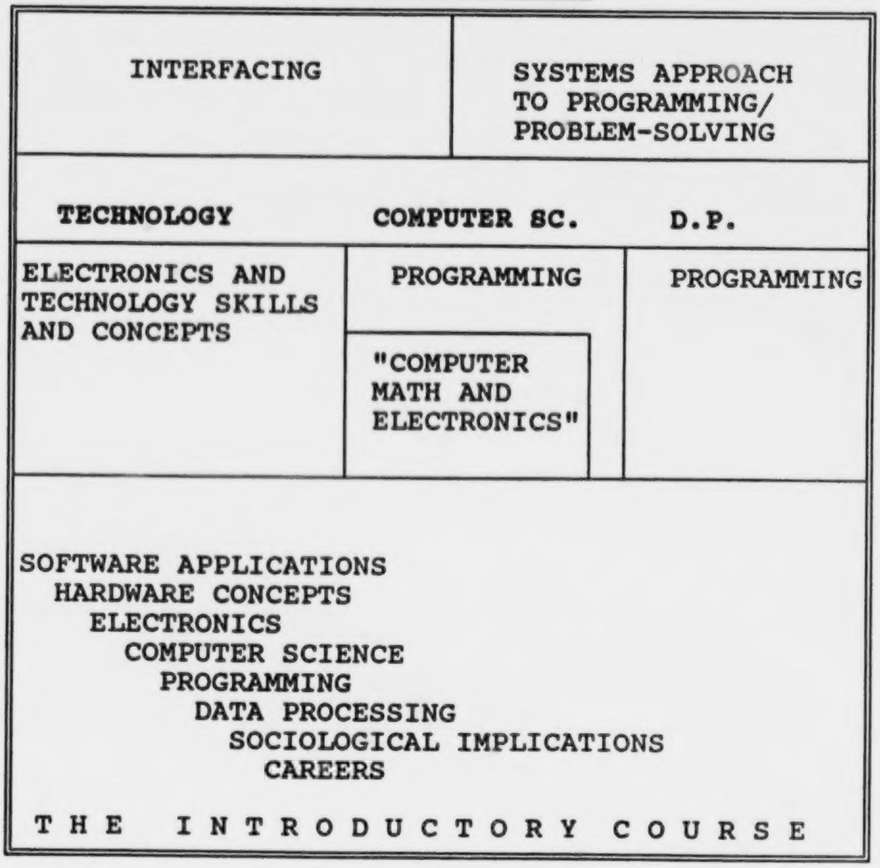
Although not directly related to the theme of this paper, the computer technology stream provided up to 4 credits at the average level in computer electronics and technology at the grade 11 and 12. This stream would be similar to most vocational courses in other provinces and possibly in most states in the United States. Such courses prepared students to enter our vocational colleges to become technicians.

Advanced level students heavily involved with technology were urged to take the grade 11 computer science and technology course which provided the background for a senior course in interfacing.

SUMMARY

The current goal of the Ontario Ministry of Education is to provide as many students as possible with a broad introduction to computers which ranges from computer electronics, programming, etc., to the sociological impact of high technology. Such a course helps students to identify what future courses they would like to pursue, (or not pursue!). At the very least all students would have a knowledge of the uses, and general operation of a computer. 'Computer math' and electronics components were inserted into the second year computer science course. Such a course provides students with a good background in programming as well as a good understanding at the conceptual level of what goes on inside the computer. Secondary school graduates of this program are better able to stream themselves into various courses at university. In time we should have a very 'computer technology literate' group of people working in a wide range of professions within our economy.

COMPUTER STUDIES



INTERFACING

SYSTEMS APPROACH
TO PROGRAMMING/
PROBLEM-SOLVING

TECHNOLOGY **COMPUTER SC.** **D.P.**

ELECTRONICS AND
TECHNOLOGY SKILLS
AND CONCEPTS

PROGRAMMING

"COMPUTER
MATH AND
ELECTRONICS"

PROGRAMMING

SOFTWARE APPLICATIONS
HARDWARE CONCEPTS
ELECTRONICS
COMPUTER SCIENCE
PROGRAMMING
DATA PROCESSING
SOCIOLOGICAL IMPLICATIONS
CAREERS

THE INTRODUCTORY COURSE

THE ROLE OF SCOTTISH LOCAL GOVERNMENT IN IMPLEMENTING THE NATIONAL STRATEGY ON COMPUTER EDUCATION

James Graham

ABSTRACT

This paper identifies that local government plays an active and crucial role in the formulation of a strategy for the implementation of new technologies in education. Local government also has the responsibility to develop and finance the operational policies. Senior officers within local government have both membership and chairmanship duties on major central government research institutes and committees. There is always a healthy tension between central and local government officers, but new information technologies have helped develop a co-operative framework.

BACKGROUND

Before evaluating the experiences of any country it is necessary to reflect on that country's educational structures for decision-making and on the mechanisms for implementation. Within the United Kingdom, Scotland has its own distinct educational system. The population of Scotland is approximately 5.5 million and there are some 2,500 primary schools, 440 secondary schools, and 190 tertiary colleges.

Public sector education in Scotland is a co-operative partnership between central and local government. The Secretary of State for Scotland, representing central government, is responsible to Parliament for the overall supervision and development of education within Scotland, with the exception of the Universities, including guidance on curricula and teaching methods and grants to special schools, the colleges of education, central institutions and students. These functions are carried out by the Scottish Education Department (SED) who also commission research through a number of educational organisations and agencies.

The Scottish Council for Educational Technology (SCET) is the main research and development body for microelectronics, open and distance learning, media education and learning resources. Local government education authorities are both the main supporters and customers of SCET.

Her Majesty's Inspectors of Schools are appointed by HM The Queen on the recommendation of the Secretary of State. HM Inspectorate are the principal professional advisers to the Secretary of State and they provide information, assessment and advice to Ministers, the Scottish Education Department and other Government Departments and agencies on the formation of national policy. Their advice is also available to local government education authorities.

Senior Depute Director of Education, Grampian Regional Council, Scotland
Chairman of the Scottish Council for Educational Technology
A Director of the UK National Interactive Video Centre

The actual provision of education is one of the duties of the Scottish local government education authorities of whom there are nine regional councils and three islands councils. They are responsible for the employment of teachers and other staff and for the provision of equipment and materials.

PRIMARY AND SECONDARY EDUCATION

Normally children enter a co-educational primary school at about the age of 5 and, after following a seven-year course, transfer to secondary school at about the age of 12.

The primary curriculum is not centrally prescribed; within the overall policy of the education authority, headteachers are given freedom to devise the type of education best suited to the circumstances of their pupils.

Responsibility for the content and management of the secondary school curriculum rests with education authorities and head teachers.

A NATIONAL PLAN FOR SECONDARY SCHOOLS

Local Governments have formed a self-supporting association, the Convention of Scottish Local Authorities (COSLA) to debate and coordinate areas of common concern with education as a principle subject area.

In 1983 the joint COSLA/SED Sub-Group on Microelectronics sought advice from a number of agencies on the advantages and disadvantages which might follow from the adoption of a more standardised approach to the provision of microcomputer hardware and software for schools. At the request of the local authorities SCET took on the task of examining the evidence submitted and prepared a final report "Microelectronics in Secondary Schools - a National Plan". This was approved by both SED and COSLA. Education authorities who were the main partners in preparing the Plan have adopted individual policies which are consistent with the recommendations contained in the Plan.

The working parties and consultancy groups supporting SCET are provided by the education authorities at no cost to SCET. In return, all educational software and most materials produced by SCET are free of charge to education authorities.

The Plan for secondary schools considered ways in which standards could be implemented and came to the conclusion that only a combination of hardware and software standards would meet the needs of schools.

Following publication of this Plan SCET, in association with the education authorities and the SED, prepared a programme of research and development activities which would allow investigations to be undertaken in areas such as hardware standards, the user interface, new types of educational software, and software portability and development techniques. The Plan also considered curricular interests, maintenance, special needs, training, information distribution and communications, accommodation, standards and a national system of support units. Perhaps the last area can be identified here for further discussions.

REGIONAL DEVELOPMENT UNITS (RDUs)

It was advocated that a national system involving a network of education authority financed support units interacting with a national centre would be the most effective model for implementation. These units would exist for the production and distribution, at a regional level, of software and for the creation and dissemination of information and advice in support of the curricular use of computers in education, again at a regional level. In order that this system could be co-ordinated and that the software, expertise and experiences were made available nationally, a national centre based within SCET would be necessary to complement the services and roles of the education authority units. The staffing and funding of such units was to be the responsibility of education authorities.

The RDUs included within their functions: advice, information and support; in-service teacher training; software development and distribution; liaison with colleges of education, colleges of further education, central institutions, universities and other authorities; participation in the national network with SCET; computer hardware purchasing and maintenance; training for auxiliary and technician support.

The SCET national centre would provide a range of services to each RDU and to the whole system. This rationalisation would involve the transfer of regionally-driven software development to RDUs, leaving central research and development to SCET.

SCET would also be responsible for the development and distribution of guidelines for the specification of programs, for program presentation and documentation standards and for the induction training of programmers for RDUs.

A NATIONAL PLAN FOR FURTHER EDUCATION

Following the publication and success of the National Plan for secondary schools, the education authorities considered it necessary to develop a further Plan - a National Plan for Further Education (FE). Following detailed research and discussions "Microelectronics and Information Technology in Further Education - A Plan for Scotland" was published.

This plan covered curricular issues, administration, training, purchasing policy, maintenance, software, interactive video, hardware and the need for New Technology Units. It may be appropriate here now to concentrate on the support features of New Technology Units which represents a major support input by education authorities.

NEW TECHNOLOGY UNITS (NTUs)

The education authorities and SCET came to the same conclusion that a model was necessary which could support both local and national requirements through Regional Units. Each Unit would be placed at a nominated college. As stated earlier further education is the responsibility of education authorities and they agreed to implement the model taking responsibility for staffing, finance and operational methodology in co-operation with the SED.

This National Plan envisaged a network of support for the new technologies in FE. Each college would have a member of staff, a New Technology Support Officer (NTSO), responsible for the flow of information between the college, regional and national agencies. Nominated colleges would house a New Technology Unit with a small multidisciplinary team serving a group of colleges through the NTSOs.

The function of these NTUs would include the implementation and evaluation of new ideas at regional level and co-operation on national initiatives. The central research and development function would be the responsibility of the existing education authority and the SED supported central unit, the Microelectronics Educational Development Centre (MEDC).

INTERACTIVE VIDEO

Local government education authorities have many areas of co-operation and concern where collaborative sharing of resources and inter-regional materials development are essential in order that a small country such as Scotland keeps pace, and of course sometimes leads, in the new technologies. Open Learning and Interative Video are two prominent areas. However, in the time and space available it would be appropriate to merely place a marker here for debate with respect to Interactive Video.

Interactive Video developments are the interest of both local and central government. The National Interactive Video Centre is a UK organisation and is the focal point for the development of and debate on this subject. Local government education authorities still, however, maintain their own development projects in order that local needs are satisfied. As well as enjoying local and central government support, Interactive Video is supported by the commercial and industrial sector, with all parties co-operating within a UK national framework.

Sugar and Spice: Strategies for Involving Female Students with Computers

Rita Haugh Oates*

ABSTRACT

When computers first appeared in schools, they often were placed in a math or science class and may have been reserved for use by advanced students. Thus, the initial audience for computers was predominantly male. Studies reported in 1983 in Psychology Today and Popular Computing stated that only 33% of students using computers were females. Today, as society has become permeated with computer applications, it is vitally important that all students have access to and become comfortable with computer hardware and software. Female students, particularly those with the aptitude and interest in programming techniques, should be enrolling in computer education courses in the secondary school in numbers equal to male students. In the Dade County Public Schools, about 45% of students in computer education classes are female. Teachers and administrators must work together to encourage and promote the concept of sex equity in the use of computers in all schools.

State-level efforts to involve female students in Florida

In 1984, the Florida Legislature passed the Florida Education Equity Act, which guarantees that no one shall be denied the benefits of any education program or activity on the basis of race, sex, national origin, marital status, or handicap. Because of this law, school districts must prepare plans for implementing equity in the classroom. Some attention has been directed toward the enrollment of females and minority students in advanced mathematics, science and computer education courses, where these groups may have been traditionally underrepresented.

The Florida Department of Education (DOE) has organized activities to promote participation of female students in computer education courses and in computer contests. In August 1988, the DOE sponsored a conference on sex equity in computing contests and paid for the computer education administrator and one classroom teacher from each of the 67 school districts in the state to attend. A series of presentations, panel discussions, and roundtables allowed participants to share successes and strategies for increasing entries from minority and female students in computer contests.

The DOE sponsors a computer programming contest each spring, and the top three teams from each school district may attend. In the past, the teams have been almost universally male. A series of applications contests for grades 1 through 12 have been designed by staff from the University of South Florida, which runs the contests. These applications contests were designed to involve more female and minority students in a computer competition.

The Florida Department of Education contracted with the University of Central Florida to develop reproducible worksheets that teachers could use for computer literacy instruction in grades 3, 5, 8 and 11, and in general the materials have gender balance in the use of male and female names and in the kinds of things that children do with computers. The DOE also provides some funding toward a journal published at Florida A&M University. Called Florida Educational Computing Quarterly, it contains a section in each issue titled "Computer Concerns for Minorities and Women."

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District efforts to involve female students: Dade County

The Dade County Public Schools, which serves more than 264,000 students at more than 250 school sites, prepares a five-year plan with measurable objectives. Several relate to goals of increasing enrollment of female and minority students in secondary computer education courses, as prescribed by the Florida Education Equity Act.

Start them young: Elementary school strategies

To increase the enrollment of females in higher level programming courses, we must ensure that they have the foundation of logical thinking skills and lower level computer education courses. Students who have had a negative experience with computers in the elementary school will be less likely to enroll in courses in the secondary school. Thus it is important that even in the primary grades female students are encouraged to use computers.

One district strategy that has been particularly successful in increasing the involvement of female and minority elementary age students is SPICE: Summer Program In Computer Education. Four elementary schools were chosen in 1983 to initiate this program. Each summer more schools have been added. During summer 1988, a total of 25 schools participated, serving more than 2,000 students during three two-week sessions.

The SPICE program focuses on using computers within a subject or on combining several subjects with computers. For example, one school combined art and writing instruction so that students could write and illustrate their own books using computer-based tools. This content focus explains why SPICE is popular with many female students: The computer is a means to an end, not an end in itself. Programming is introduced to some students through Logowriter, a software package combining Logo programming with word processing. But the overall focus of the two-week sessions is not programming. Software that encourages the development of logical and creative thinking skills is included in the recommended list.

In its first summer in SPICE, a school generally receives at least six computers, a printer, a modem, a supply of computer paper and ribbons, and at least $500 of software. In subsequent years, an additional computer or peripherals, and additional supplies and software are provided.

The most crucial part of this summer program is the selection of teachers and software. A suggested software list is prepared by the district's staff in Computer Education and Technology, with selections in a variety of subject areas. A particular teacher or school may choose to replace a district selection with something else. In general, however, because the district list contains the newest software products on the market, the schools accept the proposed list. This also encourages teachers to support each other in learning to use new software, as they have peers who are using the same materials.

Certainly, the SPICE program cannot serve the needs of all students in the district. But providing teachers the resources and time to work with students and to experiment with computer-based activities creates "spill-over" to other students and teachers in that school during the regular school year. Each school's activities are publicized in September in an extensive article in the district's monthly publication, Computer News, so that other schools can benefit from the strategies and ideas developed.

Strategies for all schools

A brochure titled "Do your female students say 'No, thanks' to the computer?" was provided to all computer education teachers at the beginning of the school year. Developed by the Women's Action Alliance and funded by Apple Computer, it contains information on the gender gap in computer use in school, in the home, and other places. While many of the six ideas for involving female students, taken from*The Neuter Computer,* are fairly obvious, this brochure provided a stimulus for teachers to examine their own practices and renew their efforts to provide access to computer activities to females.

The district has also prepared workbooks and teacher guides with content and exercises tied to the Florida Minimum Student Performance Standards in computer literacy. The state requires that students in grades 3, 5, 8 and 11 master content about using computers in a responsible manner, both in proper handling of hardware and software and in social responsibility issues such as privacy, copyright, and effects of computers on society. In addition, some preprogramming concepts are included, such as following directions, noticing whether a step from directions is missing, and writing directions.

District-developed workbooks were sensitive to the racial and ethnic diversity of south Florida and used names such as David and Daniel (common in Anglo, Hispanic and Jewish populations), Pat (both a male and female name) and others. More important, the narratives about computer users included females who were doing more than word processing.

Articles published in **Computer News** report district enrollment statistics in computer education courses and review books that might suggest strategies for involving female and minority students. These articles demonstrate to teachers and administrators that the district is committed to enrolling a diverse population in computer education courses.

The best tool for promoting computer use: individual teachers

The greatest effect on females in using computers is provided by enlightened teachers. Teachers who have been successful in recruiting and retaining large numbers of female students to use or to program computers were invited to speak at the district's fall computer education conference. Some of their ideas are:

--At the elementary school, teams of students create magazines using the computers. A group of boys works together on one magazine, while a group of girls works on another. The common focus for each group was the topic of the magazine. All students were performing the same activities but doing so in a way that interested them. Importantly, the boys weren't left out of the activity.

--In the middle school, a female teacher talked about how she worked on the self-esteem of the female students that she saw had an aptitude to go on to programming classes. "The girls are terrified," she says, "and they don't think they are good enough to do as well as a boy." She encourages specific individuals to enroll in courses. In addition, she goes to the guidance counselor with names of students who should go into particular classes.

--Some teachers try "bring a friend to the lab" day. Girls bring other girls, and boys often bring girls, too. This activity gets many female students exposure to the teacher and the lab.

--In a high school, a male teacher of advanced programming courses tried individually counseling capable female students, suggesting that they could handle AP Pascal and possibly earn some college credit. He was amazed that his enrollment went from only three females one year to seven females in AP Pascal after he did individual counseling. This made the class 46% female, a major difference from the county-wide average of 19%.

Media accuracy in showing school computer use: an anecdote

Even when a school succeeds in balancing students by both race and sex, sometimes it is difficult to show this balance. A local TV station reporter wanted to interview some students about their use of computers, so we arranged for a visit to our computer technology magnet middle school. Its students, in grades 6-8, are slightly more than half female. I called the school to ask them to ask some students to be in a particular computer lab.

When we arrived, 16 males and four females were in the lab. Few females had volunteered because they wanted to work on their homework, not be on TV, during the last period of the day. I went next door and asked for more female students, so that the sex and race balance were accurately pictured. After the cameraman panned across the room, the reporter wanted to interview individual students. He asked for volunteers, and two white males were the first to do so. After he taped them, he was ready to leave, and the dismissal bell rang.

I asked that he interview a girl, so he chose a white girl. By then, the school buses were leaving. I asked if he would also interview one or two black girls who were walking home. He said, "We really have enough." But the two girls looked so disappointed that he graciously agreed to interview one. She had excellent comments and ultimately was the student who had the greatest "air-time" in the story. While I appreciate the reporter's kindness in letting me help make the visual images present an accurate view of that school, I regret it was needed. Computer teachers and administrators must be aware of the need for balance in media coverage in the use of computers.

Female enrollment in Dade county computer education courses

The district tracks students on race and sex enrollment in all courses, through a sophisticated MIS system. This allows for examination of enrollment in courses by race, sex, grade level, or even stanines to determine if appropriate students are placed in classes. During the period of fall 1986 through fall 1988, the enrollment in computer education classes of a semester or longer by females ranged from 43.7% to 45.5%. (The differences between semesters were not statistically significant.) The percentage of female enrollment in a given course, however, varied by the type or difficulty of course. Introductory or applications courses had the largest overall enrollment and the highest proportion of female enrollment, ranging from 46% to 54% between 1986 and 1988. In contrast, the most advanced courses in the curriculum, AP Pascal and other advanced programming courses, had a much lower percentage of students. In fall semester 1988, enrollment in higher level courses was:

Course	Female Enrollment	
Advanced Placement Pascal	19%	
Programming III	20%	
Programming II	28%	
M/J Intermediate Programming	38%	(the highest level middle/junior high course)
BASIC I	40%	

The total enrollment in these five top-level courses was just 10% of the total enrollment in computer education courses. It is hoped that as the numbers of females in the other courses, which have good sex balance, will be reflected several years later in higher percentages of female students enrolling in more advanced programming courses. All the classes mentioned above except for BASIC I are year-long courses. Female students are more likely to enroll in semester courses rather than year-long courses. (chi square=54.6, df=1, p<.005) Thus, counselors and teachers need to be aware of this phenomenon and perhaps offer more semester courses and also encourage more females to enroll in year-long courses.

At the same time, however, students will be likely to encounter computers in almost any subject area in our schools. Students who are not interested in programming classes may find a computer in the music and art classrooms, in the science lab, in the home economics classroom, and in the media center. Female students need to have the opportunities to learn about computers and their appropriate uses, and we are trying to help them do so.

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INTERACTIVE VIDEO IN LANGUAGE TEACHING: LEARNING FRENCH WITH PIAF

Janne Wandall *

ABSTRACT

The paper deals with an interactive video experiment in language teaching at a Copenhagen upper secondary school. The students were taught French by means of an interactive video production based upon the film "Tout Ensemble" about the life of Edith Piaf.
Judging from the teachers' and the students' evaluation of their involvement, it appears that interactive video inspires and motivates the students, and that the level of activity in the classroom is strengthened. This is considered a great advantage - not least in teaching French, being difficult and the third foreign language for Danish upper secondary students.

INTRODUCTION

An increasing number of upper secondary schools in Denmark are using computers in language teaching. During the latest years both hardware and software have been available in most schools, although the software is not always up to an educational standard.

Tape recorders and video machines have been used for an even longer period of time. The advantage of these media is that students can listen to authentic speech as well as watch the non-verbal language.

Interactive video represents an opportunity to combine the different media. The idea of interactive video (IV) is to let a video programme be controlled by the student by means of a computer, so that the advantages of the film medium are reinforced by the computer.

On an experimental basis, a small IV application has been used in Denmark in teaching French in the Gymnasium (16-19 years old students, A-level).

One of the main points in using IV in language teaching in schools to-day could be that it is highly motivating, so that students are active and interested during the learning process. This motivation is very important, especially in French because it is a difficult language to learn for many Danish students, and because the third language is a low ranking subject in the Gymnasium. Therefore French was chosen for the experiment.

The experiment started in January 1987, and it went on for 8 weeks. It took place at Christianshavns Gymnasium, an upper secondary school in the city of Copenhagen. 250 students (17-19 years old) and five teachers were involved in the experiment. Besides the author, the following teachers took part in the experiment: Anne Marie Eriksen, Lis Kornum, Lisbet Lindberg and Birthe Okholm.

The IV application was based upon a film, "Tout Ensemble", about the life of Edith Piaf. During the entire period of the experiment, the French teaching was related to Edith Piaf, also when the students did not work in the IV-room. Two out of three weekly lessons were spent in front of the computers. In the remaining weekly lesson, the students worked with articles from French and Danish magazines about Edith Piaf herself and about her songs. This gave an opportunity to compare the film with the different texts.

The film about the life of Edith Piaf has a duration of 90 minutes, of which the first 35 minutes were stored on a video laser disc. The computer programme was on a floppy-disc. The software and the interactive system have been developed by Torsten Alf Jensen, JJKS Aps, a Danish software consultant firm.

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The project was financially supported by the Danish Center for Education and Information Technology (CPI), who also provided the Gymnasium with equipment for the experiment. Additional equipment was lent from the Copenhagen Center for Information Technology (Københavns Kommunes Teknologi og Informatikcenter).

THE TECHNIQUE

Two adjoining rooms were used for the experiment. One was a small studio with two IV work-stations, the other was an ordinary classroom. The configuration used in the two work-stations was a Philips VP 835 video-recorder connected to an IBM PC. Each station had two screens: one for the text and one for the video.

Each class was divided into two groups, one of which worked in the IV studio, while the other worked with the teacher in the classroom next door. As the two rooms were adjoining, the teacher had the possibility to leave the students in the classroom if help was needed in the studio. The number of students working at each workstation was normally 4, but in certain cases we had to admit 5 at one machine. It was a problem to have two workstations in one small room, since the sound from the film at one station disturbed the students at the other, and vice versa. Using earphones might be a solution to this problem, but then you loose the possibility of communication between group-members during the work.

The application being only a provisional prototype, it had some technical faults, which may have had an impact on the learning process. However, this impact was not severe, as student autonomy and the ability to explore and ask questions were key features in the application. The machines were meant to serve only as tools, while the students should be in command of the learning process. The students' task was to ask questions, not to answer them, making full use of the possibility to store and display data.

The function keys on the key-board were programmed for the following facilities:
- to start the video from the beginning, just to see and to listen to the dialogue
- to have the dialogue displayed as text (one period at a time) on the text screen simultaneously with the playing of the video
- to stop the video at any moment, and continue from that very point
- to speed up the playing of the video
- to jump, i.e. go very quickly through a passage of the video (quick speed and jumping can be either forwards or backwards)
- to have the frame numbers displayed on the video screen in order to find a special scene, or even a single word or movement, as the system enables you to stop at any of the 54.000 frames of the disc
- to have the last word or period repeated on the video
- to get the translation or the grammatical explanation of a single word by pointing with the cursor on the text screen
- to choose between Latin, Danish or French grammatical designations
- to have a given word or phrase replayed on the video by marking it with the cursor on the text screen
- to prepare and solve cloze-like exercises on the text screen, for instance leaving out all the adjectives from a marked text in order for the student to fill them back in.

So, the idea of the experiment and the application was to let the students work within a communicative entity and define the learning process and the exercises themselves. This principle was not fully worked out in the experiment, as the teachers to some degree had planned the learning process in advance. Therefore it was necessary for the teacher to intervene and control the learning from time to time.

THE PEDAGOGICAL PROCESS

As a start of the experiment all students watched the Piaf-film in full. The next lesson was used for a demonstration of the facilities in the system, and the students had opportunity to try it out. A group of four or five students worked at each of the two work stations. One student operated the key-board, while the whole group discussed the problems presented on the screen and took notes. The operator job was taken over by another student the following lesson.

During the first couple of weeks, the groups in the IV-room and the group in the class-room took turns after half a lesson, so that all students in the class were working with the same texts and sequences of the film within one lesson. In this way all students could have the same homework assigned. However, we gave up this principle, because it was too time consuming to move from one room to another and start the machines twice during one lesson. So, for the rest of the weeks, the groups worked independently of each other.

The students were asked to do exercises related to the different scenes in the film, in order to force them to use all the different facilities of the system. Doing this, they had the opportunity to train their ability in:
- translation, both French-Danish and Danish-French
- listening to French and understanding it with help from the intonation and the non-verbal language
- analyzing the content of the film - both pictures and sound - and un derstanding the meaning of the film
- awareness of details related to the social context of the film, for instance the difference in behavior of various social classes in France at the time of the film
- speaking French, for instance by doing dialogue-exercises such as role play and imitations.

The grammatical exercises were an optional facility in the software. All the teachers observed that this facility was hardly used. Grammatical exercises did not seem very interesting to the students, compared with all the interactive possibilities. Also the function key programmed for "grammatical explanation" was seldom used.

The most popular facilities were the "translation" key and the "repeat" key, both of which gave the students an opportunity to overcome problems of understanding the spoken French, and thus made it possible for them to work more in detail with the content of the film.

The pedagogical process demonstrated that it is important that the dialogue of the film is very distinct. If the speech is too fast - as is the case in some parts of the Piaf film - the students concentrate too much on the text screen and forget the sound and pictures of the film itself.

REACTIONS OF STUDENTS AND TEACHERS

All students were asked to comment on their work in relation to the IV system during the experiment.

The general impression was that the students liked very much to work with the system. They were highly motivated for learning, which is very seldom the case in French. They even went on working during the break after the lesson - something which never occurs after ordinary lessons.

The students were eager to find new ways of working with the system, and they became familiar with the many possibilities of the key-board very quickly. So without doubt, the experiment demonstrated that the students gained a good understanding of information technology. However, it is more difficult to prove that they learned more French than from ordinary lessons.

Some of the remarks from the students support the view that the students got a better understanding of the film by using the system:
- You remember everything better when you work with sound and pictures, and solve the problems yourself
- IV makes it easier to understand the action of a film.

Students also commented on the technical set up. Typical comments were:
- Fine to have the dictionary built into the system
- Too many machines in one room disturb one another
- Too bad that you could not have a whole sentence translated at a time
- One should be able to reduce the speed of the dialogue.

After the experiment each teacher worked out an evaluation report to be presented at the final evaluation meeting.

We all agreed that during the lessons of IV, the students were very interested, and the level of activity was very high. So, it is a likely assumption that the use of IV in teaching facilitates the learning process and improves learning abilities. Yet this assumption was not directly proved by the experiment.

But even if this proof is lacking, there is no doubt that using IV does have a very positive side effect, namely that the part of the class not working at the work stations, can be taught very intensively. With only 10 students, you have the opportunity to train every student at his or her own level. In this way the use of AV (or any other kind of information technology which can release the teacher in some way) does contribute very successfully to an improvement of the ability level of the class.

The optimal number of students working at one work station is 3. Then they can work together, help each other and discuss the possibilities and proposals for problem solving.

This system was based on two screens. During the most difficult film dialogues, the students were tempted to follow the text screen only, so that they missed the pictures with the non-verbal language, which might have helped them to understand. Therefore, we recommend more simple dialogues, when using a two screen configuration.

PERSPECTIVES

IV can without any doubt be very useful in language teaching. IV inspires and motivates the students, and the level of activity in the class is increased. The students experience that the sound, the pictures and the text play together, and the teacher obtains a possibility to train authentic language more intensively, also incorporating the non-verbal language.

An IV-system brings us as close to total-communication as possible without going to the foreign country. Therefore this technology is a promising tool in foreign language teaching.

DEVELOPMENT OF INTERACTIVE VIDEO LEARNING PACKAGES FOR THE I.T.V. COMPANIES

R Wilson and A Elsayed

ABSTRACT

An outline is given of the education and training courses specifically provided for engineering staff from the Independent Television companies. This led to the support for the development of the interactive video learning packages described, thus enabling Leeds Polytechnic to become one of the first academic institutions in the U.K. to venture seriously into this area. The place of interactive video computer based training in the I.T.V. companies is discussed along with the methods used to determine the content of appropriate learning packages. The courseware design adopted the approach of the enhanced Electronic Book. This design philosophy is discussed. In addition the software tools and hardware configuration used in the development/delivery workstation are indicated.

INTRODUCTION

The Independent Television companies in the United Kingdom have an association representing all of them and known as the I.T.V. Association.
One of the roles of this organisation is to help member companies by establishing, with external providers, training for I.T.V.staff.

Different areas of activity are accommodated by various colleges and professional organisations. The training is separated into that required by Producers and Directors, Technician and Operational staff, Engineering staff, Journalists, and Actors. Leeds Polytechnic has been, since the 1970's a provider of education and training courses specifically for Engineering staff from the I.T.V. companies.

A range of intensive short courses have been developed over the years and have included courses on:

- Current Television Techniques
- Digital Electronics
- Digital Sound
- Digital Television Systems
- Microprocessor Programming and Applications
- Colour Television Principals and Practice
- Television Studio Measurements

Recognition of the role that the Polytechnic played in providing this training was given by the I.T.V. Association in awarding, from 1984, several grants. These awards were used for a variety of purposes that enhanced the standard of training for I.T.V. staff. The most recently received grants included support for research and development of computer-based interactive video learning packages of relevance to the Broadcast Industry. The award enabled the Polytechnic to employ a Research Fellow with experience in this area, and funded the establishment of a prototype workstation for the development, delivery and evaluation of suitable packages.

Leeds Polytechnic, U.K.

EVALUATION OF TRAINING NEEDS

The advantages of distance learning and open learning packages have been thoroughly discussed within the I.T.V. Association. The benefit to the individual of a 'student centred' self-paced teaching system that could be returned to as often as required was clearly recognised. A need that could be met by the combination of powerful personal computers interfaced to video disc technology.

The I.T.V. companies have a requirement to consistently improve and revise staff skills and knowledge as equipment and techniques change rapidly in their industry. The computer-based interactive video approach allows training to be conducted on-site and at times which suit the company thus providing a cost effective solution.

Clearly an analysis of the Broadcast Engineering needs of the I.T.V. companies was required in order to determine the content of appropriate learning packages. This analysis was carried out using two methods. The first involved visiting a sample of I.T.V. companies to engage in discussions with a variety of senior staff to investigate training needs. The second method was to prepare a briefing sheet to outline the project and its aims; then to circulate this together with a questionnaire to all member companies. The questionnaire was designed to identify the following:

(a) Subject Areas
(b) Level of Presentation
(c) Nature of Instructional Content
(d) Training Objectives
(e) Learning Environment
(f) Background of Trainees
(g) Level of Motivation

A study of the responses from the questionnaire and the visits led to the conclusion that a series of initial modules on Digital Techniques was needed. The approach should be to facilitate a transition between the analogue techniques familiar to the trainees and a set of more advanced modules to be developed on Digital Television and Digital Video Recording Techniques. The initial work was therefore directed towards these aims by developing modules on Sampling composed of sections on:

* The Concept of Sampling and the Moving Picture
* Sampling Electrical Signals
* The Digital Signal, Quantisation and P.C.M.
* Time Division Multiplexing
* Recovering a Continuous Signal
* The Frequency Spectrum
* Sampling Rates

The way in which the courseware was designed, and the philosophy behind the adopted approach of the Electronic Book is discussed in the next section. The development and production aspects of the target courseware will be reported in a future publication.

INSTRUCTIONAL DESIGN

The design process in this project was to define the learning objectives that can be most effectively satisfied by the Interactive Video media and hence develop the structure that utilises this media efficiently.The learning objectives here are concerned with the type of exposure to which the learner would be subjected during the course rather than with the degree of mastery of some specific topics in a specific subject area that is expected from the learner at the end of the course.

Two learning objectives have been identified for evaluation in connection with the IV media. The first is to develop in the learner an awareness about a specific subject based on recordings of real life events. This objective aims at providing the learner with an experience that is second only to a real life encounter. It is this objective that was realised by all educational and training professionals involved with the IV technology, who saw in it an unrivaled media. The second objective exploits the real potential of the IV technology, that is to develop in the learner a working skill by providing him with a guided and controlled hands on experience supported by integrated instructions. The work reported here relates to the first objective. The authors work in the second area is described in another paper in these proceedings.

To realize the first objective in developing an IV learning package on 'Sampling' the approach of the 'electronic book' was adopted. The electronic book approach is based on a multimedia computer controlled presentation that draws from an environment consisting of moving picture (video), audio, graphics (still and animated) and text. The structure designed for this course provides for five essential features:

* A non-keyboard learner interaction using only pointing devices (e.g. touch screen, mouse, etc.);
* a tree structure for top-down access;
* a linear presentation for the instructional material;
* a suitable set of note-taking pauses;
* a go-back facility for segment repeat.

The first feature simplifies the user interaction and enhances the user friendliness of the package. The second feature allows mid-point access within the package so that browsing, etc can be facilitated. Thirdly, the feature on linear presentation enables the learner to proceed uninterrupted by branching requirements from start to end.

The note taking pauses referred to in the fourth feature, however, are provided by suitably located breakpoints that do not seem to interrupt the flow of the presentation but allows some natural pauses to enable the learner to note down on paper a summary of the preceding segment. These breakpoints also allow for three more decisions; the repeat facility indicated by the fifth feature, down-top branching for accessing another segment and quit the programme.

The first feature described above emphasises the underlying philosophy of the design. It is based on a totally pictorial man-machine dialogue. The pictorial prompt of the system is a triangular shape that allows the above mentioned four functions as shown in figure 1. As this pictorial prompt is used throughout the package, as well as being representative of the top-down branching structure of the design, it is being adopted as an emblem for this IV production.

Although in future studies further structures that allow varaying levels of detail in presenting the same subject matter will be investigated , the present product allows only one level of detail. The top-down tree configuration of this package, therefore, is limited to providing a branching facility for accessing any of the instructional segments that constitute the base of the triangular structure. This means that the instructional material itself constitutes the base level of this structure in the form of 'instructional segments" as shown in figure 2. These segments resemble the "pages" of a printed book.

SOFTWARE TOOLS

In realizing the above design an authoring system was used for developing the graphics and text of the instructional material. It was also used as the central element for controlling the multimedia peripheral available; the laser disc player. A brief survey of available systems was undertaken after which it was decided to use the SAM authoring system. Most authoring systems available did not provide enough flexibility for accommodating the above design. This comment applies also to the adopted software system, SAM. The main reason is that most of these systems were classical CBT systems that were modified to take advantage of the emerging IV market. The authors are now considering developing a system that is more oriented towards multimedia control than merely CBT authoring.

Besides using SAM as the main authoring software tool the MIC system (Multimedia Interactive Control), from Videologic, was also used to provide the necessary interface utility to the Interactive Video Adaptor (IVA) board.

HARDWARE CONFIGURATION

The above software was mounted on a standard IBM based configuration as shown in figure 3. The role of each of the elements in the functionality of the system is obvious except, perhaps, for the U-MATIC VTR. This machine was mainly used in the development stage for reviewing the video/audio material.

LIMITATIONS AND SUGGESTIONS FOR FUTURE WORK

Interactive Video is highly acclaimed to be a truly multimedia environment. From experience it was found that this type of multimedia arrangement does have a serious limitation. It is the associative nature of the video and audio channels on the video disc. A truly multimedia system must have the flexibility of providing disassociated sources of the various media involved. The central control element can, in this case, independently access and freely mix between the different sources in a mode that fully maximises the effectiveness of the instructional delivery process. In addition, the lack of software systems that can provide an effective management tool in handling the delivery from such a multimedia environment further limits the potential benefit that can be obtained from the system. Finally, the graphic facilities associated with most authoring systems are restricted to still graphics or, at the most, very elementary graphic animations. Graphic animation is considered as a most effective tool in instructional support. Therefore most authoring systems are seriously handicapped by the lack of such an effective facility.

The development of a multimedia learning package has now been completed and demonstrated to the representatives of the Independent Television companies. Further research and development work at Leeds Polytechnic in instructional technology will address the limitations outlined in this section.

ACKNOWLEDGEMENT

The support and collaboration of the ITV companies and their Association is gratefully acknowledged by the authors.

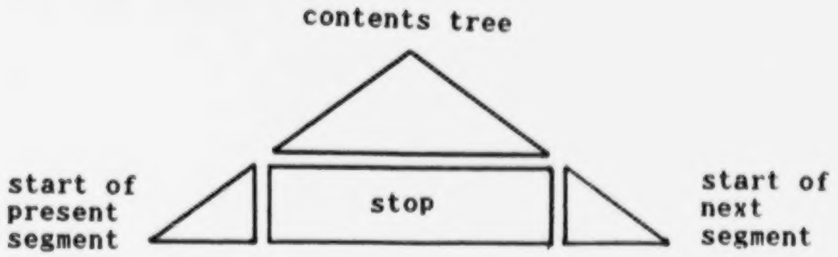
contents tree
start of present segment
stop
start of next segment

Figure 1

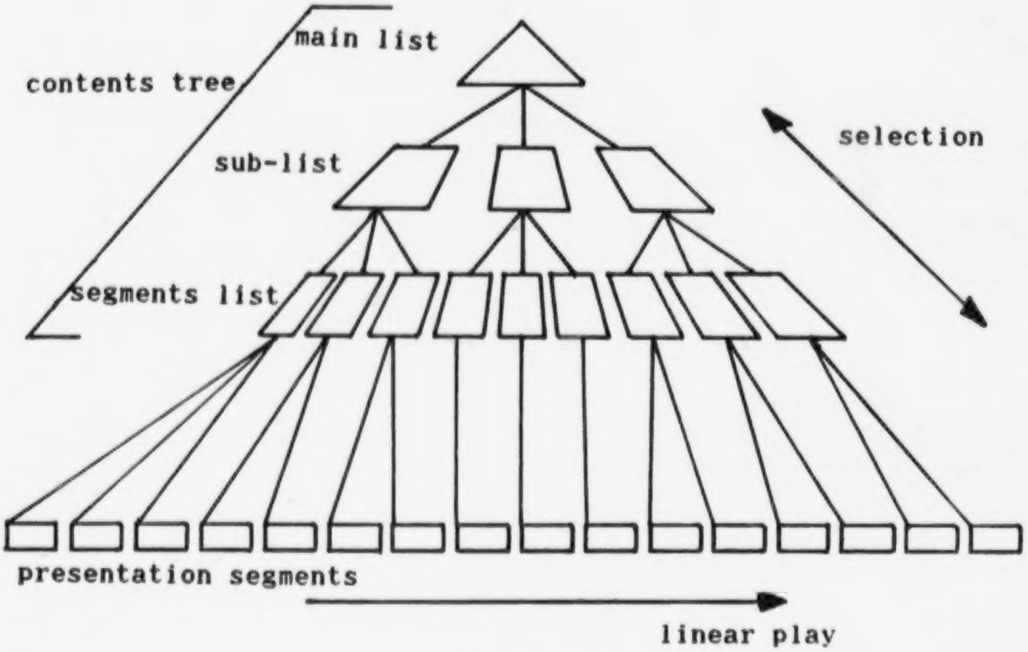
main list
contents tree
sub-list
segments list
selection
presentation segments
linear play

Figure 2

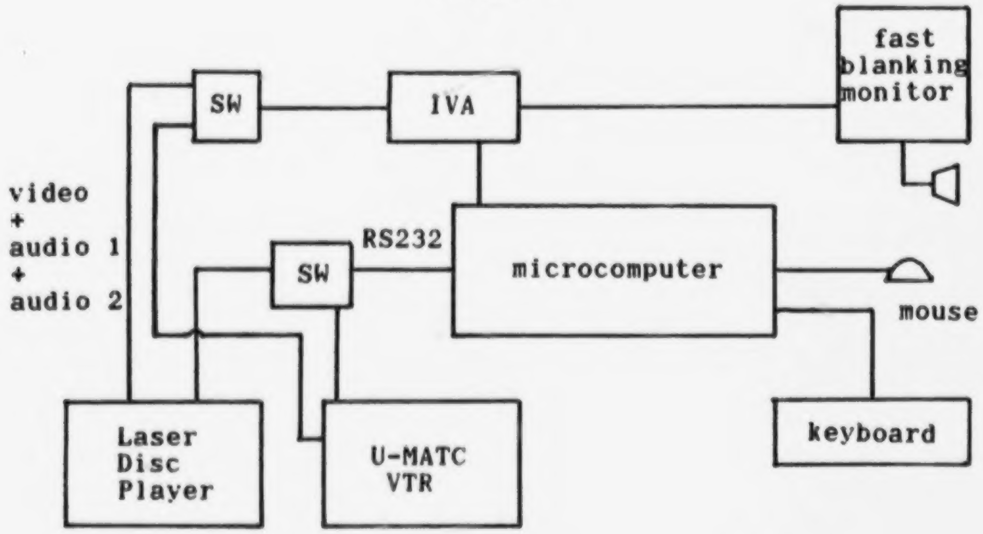
SW
IVA
fast blanking monitor
video
+
audio 1
+
audio 2
RS232
SW
microcomputer
mouse
Laser Disc Player
U-MATC VTR
keyboard

Figure 3

THE HUMAN-INTERACTIVE VIDEODISC INTERFACE-COST EFFECTIVE EDUCATION AND TRAINING WITH NEW TECHNOLOGY

Mark D. Veljkov*, Carol J. Anderson*

ABSTRACT

Effective computer based training has become a major cost for many educational institutions. The majority of users require organized instruction to productively utilize computer hardware and software. Recognizing the need for visual based, learner efficient training programs, educational and human service organizations are presently in need of cost effective computer based training.

The Syntergetics Group is part of the Program for Social Service Research, Demonstration and Training at Western Washington University. The group has developed a highly effective and cost efficient method for training educational and human services personnel using a most unique and innovative technology. The Syntergetics Group has developed several training programs using Interactive Videodisc (IVD) technology.

The instructional design phase, teamwork, needs assessment tools, subject matter research, methodology and on-going modifications can serve as models for any IVD-based courseware design.

BACKGROUND

This project began at Western Washington University with the Program for Social Service Research Demonstration and Training (PSSRDT) in the Bureau for Faculty Research. The PSSRDT currently offers numerous stand-up training courses for employees within Washington State's Department of Social and Health Services. An IVD course about the physical indicators of child abuse was developed as part of the on-going development of training programs by the PSSRDT. The Syntergetics Group is currently developing a complete IVD training package on sexual assault.

INTRODUCTION

Until recently, IVD courseware was seen as a very expensive undertaking for any organization. Now, microcomputer-based authoring systems have allowed more groups to explore IVD training as a viable option to meet a variety of training needs.

The past several years have seen an increase in the interest in Level 3 interactive videodisc (IVD) based training programs. Level 3 IVD programs combine CAI and videodisc technology to produce one of the most powerful and creative learning tools available. Over the years there have been several factors that have limited the production of IVD training programs, Cost and IVD expertise are two of the main prohibitive factors for many educators. The primary costs have been the investment in equipment and personnel. Advancements in both computer hardware and software have brought the expense of IVD development down.

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A new generation of authoring systems have been introduced which allow non-programmers to develop powerful interactive courseware to be developed. This courseware is then be integrated with videodisc technology thus creating an IVD program.

The methods presented in this paper demonstrate how an effective team of individuals can create powerful, effective, creative and cost efficient IVD courseware. The methods demonstrated utilize hardware and software that is available to anyone. Organizations can now utilize existing personnel to create IVD without the added expense of subcontracting for IVD expertise.

The Development Team

The IVD team is made up of several "core" individuals. These include;

Δ Project Manager
Δ Technical Manager
Δ Writer
Δ Video Producer

The Video Producer is optional depending upon the video needs of the specific project. Projects that are repurposing an existing videodisc will not need the services of a video producer. However, the Video Producer is necessary for projects that require original video production. This implies that there may not be a need to fund a full time position of Video Producer.

Additional team members include **Content Specialists** and someone familiar with basic instructional design. These two positions are generally found within most organizations. In fact, most of the positions associated with IVD development can be found within existing organizational structures.

Development Process

The first step in creating an IVD is to use the IVD development team to **conceptualize** what the final IVD will look like to the end user (learner or student). The next step is to **brainstorm** what types of content and visualizations could go into the IVD course. Next, the writer creates a **script treatment** of the course. This script treatment is a basic outline of the IVD which includes a complete visual treatment of what the end user will actually see. After the script treatment, the content specialist prepares basic goals and objectives associated with the specific content of the course. If a project is going to utilize original video footage for the IVD, a video script is prepared in conjunction with the Content Specialist. This generally happens shortly after the goals and objectives are written. If you plan on repurposing an existing videodisc, a script is not necessary. A rough index of the video scenes on the repurposed disc is helpful. Any generic database can be used to maintain this index.

With the course visualized, the goals and objectives written and a videodisc selected or created, it is time to author the course. Basic, "off-the-shelf" hardware and software is used to create IVD courses. IVDs are both Macintosh-based and MS-DOS-based. The authoring systems selected for our projects are:

- Δ Macintosh--Mentor/MacVideo from Edudisc, Inc.
- Δ MS-DOS--ProPI from Western Washington University and QUEST from Allen Communications

It was decided to use **authoring systems** for courseware development as opposed to a specific **authoring language** such as Pilot or C. This decision was made for several reasons.

1. Authoring systems did not require specialized and expensive personnel to write computer code.
2. The project could maker stronger use of the Content Specialists because courseware design was easier to understand and follow.
3. Initial course development is considerably faster using an authoring system. Additions and deletions were often done the same day they were suggested.
4. Authoring systems greatly enhanced the ability to utilize other applications (HyperCard, dBase III, etc.) in the course itself.
5. Authoring systems provided flexibility to maximize the team effort. We are able to concentrate on such areas as "imagineering" and creativity.

COST FACTORS

The following chart illustrates the typical cost per IVD project. One chart displays a cost breakdown for an IVD with video production services. The other chart shows a cost breakdown when repurposing.

RECEPTIONIST IVD PROJECT

IVD Fixed Costs/Yr.-Personnel	**Salary**	**Fringe**
Project Manager	$22,357.00	$5,813.00
Video Producer	$5,400.00	$1,404.00
Writer	$5,589.00	$1,453.00
Instructional Designer	$5,926.00	$1,541.00
Content Specialist	$6,900.00	$1,794.00
Totals	**$46,172.00**	**$12,005.00**
INDIRECT COSTS (overhead)	**$27,703.20**	
Disc Development Costs		
Check Disk & Mastering	$2,600.00	
Packaging	$200.00	
Replication Costs	$10.00	
Total Disc Development Costs	**$2,810.00**	
Total w/out Indirect	**$60,987.00**	
Total w/Indirect Costs	**$88,690.20**	

Sample Cost Breakdown for IVD with Video Production

SCHOOL OF EDUCATION IVD PROJECT

IVD Fixed Costs/Yr.-Personnel	**Salary**	**Fringe**
Project Manager/Technical Manager	$22,357.00	$5,813.00
Writer	$5,589.00	$1,453.00
Instructional Designer	$5,926.00	$1,541.00
Content Specialist	$6,900.00	$1,794.00
Totals	**$40,772.00**	**$10,601.00**
INDIRECT COSTS (overhead)	**$24,463.20**	
Disc Development Costs		
Check Disk & Mastering	$2,600.00	
Packaging	$200.00	
Replication Costs	$10.00	
Total Disc Development Costs	**$2,810.00**	
Total w/out Indirect	**$54,183.00**	
Total w/Indirect Costs	**$78,646.20**	

Sample Cost Breakdown for IVD with Repurposed Videodisc

Costs of course do not reflect the price of computer and videodisc hardware.

CONCLUSION

The methodology being employed in this presentation is primarily experiential in nature. Attempting to describe the IVD output from our efforts is a bit like trying to describe the taste of chocolate. A philosophical rationale for IVD implementation and development being suggested is that the hardware and software components of IVD are not as important as the usefulness of ideas contained in the IVD. We suggest that "Imagineering," or the creative use of technology becomes an established criteria in IVD development and evaluation. IVD courses devoid of this criteria will very likely not hold the learners attention or adequately meet instructional objectives despite the sophistication of the technology.

Our approach is quite radical by current IVD development standards. However, microcomputer technology is so sophisticated we have found that we can generally develop 95 to 100% of our IVD project without using any programming code. In addition, the sophistication of current video is such, that you no longer have to use 1 inch video tape to master a high quality videodisc. Could 3/4 inch tape can produce just as high of quality as the 1 inch. This puts the cost of video production well within the reach of many organizations. Now we face the advent of CD-ROMs, and Digital Video Interactive products. All of these developments serve to illustrate the exponential explosion of technology in our society.

So what about our future generations? Even now, our children have the capacity to access more information, faster than ever before. Our educators are not prepared, yet our children embrace the new technology. They had better, because it will as much a part of their lives as the telephone has become. As an information based society, we are acutely aware of the fact that "information is power." IVD is a powerful mutimedia learning tool. However, much of its effectiveness is determined by the degree to which educators and subject matter experts, can conceptualize, readily experience and implement their ideas with the new technology of IVD.

VIDEO PROCESSING WITH THE NATIVE PEOPLES OF CANADA

An Interactive Video Disk Database Project

F.E. Douglas

ABSTRACT

Video disk technology has only recently been applied for open ended and creative student use. The aim of this project was to provide elementary and secondary students with a meaningful opportunity to access both textual and pictorial information. An extensive computer database of cultural information about forty-four native people groupings was compiled from many sources including the holdings of the National Museum of Civilization. This information was divided into thirty different database fields. Live video and slides were collected to support each cell reference in the database. Through the three different levels of use, students can not only access information during research but also prepared a sequence of slides or video to act as evidence in supporting any hypotheses at which they arrive. This pictorial and/or sound record sequence can be later edited and combined with text and incorporated in a class presentation.

INTRODUCTION

This paper outlines the process involved in the development of an innovative use of computer controlled videodisk technology to enhance student investigative powers. The development process is examined. The three levels of student use are explained. The extensions of this type of learning environment are hinted at.

THE DEVELOPMENT PROCESS

An extensive computer database was created containing cultural information about forty-four different tribal groups of the Native Peoples of Canada. The initial database material was gathered from textual sources. Pictorial samples were next collected to provide visual examples of the type of data contained in each of the 1320 cells. This pictorial material was found through contacting the many museums containing native artifacts and/or film collections. The best of films and slides of the artifacts were put on about forty hours of videotape. The authenticity of the descriptions of each image was verified by the staff of the National Museum of Civilization in Ottawa, Canada. These forty hours of videotape were edited, and organized to provide approximately equal numbers of slides and movies for each of the information references. The result was a final video which could provide students with easy random access to film and audio sequences as well as the textual information contained in the database.

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The database contains information on the Native People's of Canada. These are ibal Groupings:

Tribal Groupings:

Eastern Woodlands

- Algonkin
- Beothuk
- Cree
- Huron
- Micmac
- Malecite
- Montagnais
- Naskapi
- Neutral
- Ojibwa
- Seneca
- Tobacco

Mackenzie/Yukon

- Beaver
- Chipewyan
- Dogrib
- Hare
- Kutchin
- Nahani
- Sekani
- Slavey
- Yellowknife

Pacific Coast

- Bella Colla
- Coast Salish
- Haida
- Kwakiutl
- Nootka
- Tlinkit
- Tsimshian

Cordillera

- Carrier
- Chilcotin
- Interior Salish
- Kootenay
- Tagish
- Tahltan

Plains

- Assiniboine
- Blackfoot
- Gros-Ventre
- Plains Cree
- Sarcee

Inuit

- Caribou
- Central
- Copper
- Labrador
- Mackenzie

In establishing the fields under which to organize the information for each tribal group it was decided to focus on cultural categories. These are outlined below.

Database Topics:

- Arts and Crafts
- Beliefs
- Celebrations
- Climate
- Clothing
- Communications
- Cultural Area
- Death Cerimonies
- Demography
- Economics
- Education
- Environment
- European Contact
- Family Grouping
- Food
- Health and Medicine
- Language
- Music and Dance
- Name Meaning
- Population
- Resources
- Rituals
- Rule Making
- Shelter
- Social Organization
- Sports, Games and Toys
- Tools and Weapons
- Transportation
- Treaties
- Tribal Name

STUDENT ACCESS

Three levels of student interaction are provided for in the project design. The first of these is an introductory overview through which the student gains an understanding of the migratory routes of the native peoples of North America and some insights into the meaning of "culture". A this introductory level the student is quite passive in the learning situation, but is gaining the necessary background or overview information with which to base future inquiries.

This native peoples' awareness section puts the students into the role of the archaeologists/anthropologists. Through the use of a modified database interacting with the videodisk, students investigate images connect with a specific native peoples' tribe or category. Growth takes place through the use of "probes" - questions that guide or focus the learner to a particular point or a larger section of an image.

At the second level the students are engaged in a guided dialogue through which they focus on the decoding strategies of interpreting visual images and gathering, generalizing, and hypothesizing about the content in these images. The student becomes involved in limited data searches based upon probes provided in the interactive dialogue. The student can review at any point the recent images viewed and select those which best support a theory in its developmental stage. Access is limited in level two to sections of the database appropriate to specific skill objectives. That is, images of are artifacts are not shown if the skill focus is not decoding background and foreground information from landscape images.

Probes are drawn randomly from a bank and thus students can use level two many times to expand analysis skills without becoming bored. Samples of viewing and analyzing probes are as follows:

Location (establishing the locale of the image or action taking place)
1. Where is this scene taking place?
2. What is the location of this scene?
3. What does the background of this image tell you about its location?
4. How does the foreground provide you with clues about where this is taking place?
5. In what kind of surroundings is this action taking place?
6. What do you think exists to the right/left of this image?
7. What do you think exists closer/beyond the background of the viewer?

At the third level the options for the student are most open-ended. In this option students have complete freedom to explore the large database. Individual topics can be researched or the student can try to verify generalizations through multiple field search criteria. Students are presented with textual and numeric information on the computer screen and a series of slides or real-time movies on the video monitor. Students can select sections of text from the database to include in a built-in word processor. A video processor allows students to develop sequences of video images for playback in a presentation. There is an ability to produce hard copy of bbth visual and textual information.

INTERACTIVE VIDEO : A NEW WAY TO MEET PERSISTENT TRAINING PROBLEMS OF PARAPROFESSIONAL HUMAN SERVICE WORKERS

Ihor Cap*, Orest Cap@.

ABSTRACT

For the purposes of: a) developing a knowledge-base for the continuing training needs and on-the-job problems of human service workers with the elderly of diverse backgrounds, and b) creating opportunities for various agencies and cultures to exchange information in their ongoing search /development process of problem solutions, this paper briefly reviews the Elderly Service Workers' Training Project's (ESWTP) 4-year effort (1983-1987), sponsored by Health and Welfare Canada, focusing on the development of an

*instructional delivery program for human service workers experiencing problems in their daily interaction with the elderly of four ethnic groups in the province of Manitoba: (1) Ukrainian, (2) French, (3) Native, and (4) German.

*interactive video (tape) system to meet their training problems.

INTRODUCTION

There is evidence to show that substantial investments are made and will continue to be made well until the year 2000 for the training of workers (ref 1). In 1987, a national industry survey, representing 14.8% of all U.S. organizations that had at least 50 or more employees, reported an estimated 32 billion dollars budgeted for the training of their workers. The total average training expenditures in the health services industry for the same year was estimated at over 31 million dollars (ref 2). Further, 53% of all corporate training efforts are in some way connected with computers. Of all the 1987 respondents using interactive technology as the training medium, 20% reported using interactive videodisc, 31.7% reported using videodisc, 70.1% reported using interactive videotape and 80.4% reported using it in an self-paced training format (ref 3). Management skills/development, supervisory and communication skills training top the list of all course offerings and the demand is persistent (ref 3). According to Zemke, one of the principal reasons behind this persistent demand is believed to be associated with "the minority rights movements of the 1960s and 1970s" (ref 4).

In 1983, U.S. health care expenditures reached $355 billion dollars or about $1,500 per capita (ref 5). By 1986, these expenditures rose to an estimated $465.4 billion, or nearly $1,870 per capita (ref 6). In the wake of concern:

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for containing health care costs (ref 5,7);for the ever growing elderly population and the rising proportion of elderly ethnic minority groups (ref 8);for the delivery of efficient and effective services to America's elderly, and the meaningful pursuit of elderly activity within the broadest range of civic,social and cultural needs and opportunities (ref 9,10,11,12);for the increased demands on service providers (ref 6);for the unfavourable staff attitudes toward the ethnic and minority elderly, and prejudice from and toward "Anglos" that is fostered by the lack of appropriate pre-service or in-service training (ref 10,13);and the concern for developing and implementing a unified manpower policy as required by Section 402(b) of the Older Americans Act of 1965, as amended (ref 14), various administrations, public and non-profit agencies and institutions are searching for ways to address these and other problems associated with the delivery of services to the elderly population. It becomes apparent that the ongoing challenge of successfully removing and reducing any services delivery problems requires increased understanding and knowledge of the ethnically different and culturally diverse backgrounds of elderly-clients. Governments are continually seeking new ways to ease the burden of health care costs and alter negative behavior patterns and practices. However, training costs can be substantial. Because human service providers represent a very sizeable and diverse range of workers, the utilization of various computer-based technologies of instruction are becoming an increasingly attractive approach for providing health care training (ref 15,16,17,18, 19).

BACKGROUND TO THE PROJECT

Canada is still a very young nation, but each year a greater proportion of its population join the "ranks" of the older adult. At the present time, statistics show that 9.7% of Canada's population is over 65 while in Manitoba 11.9% of the population is over 65 (ref 20). Older adults represent the fastest growing group in our nation and are projected to increase even more rapidly in the next decade.

Working with the elderly not only requires an understanding of the elderly but it requires also an awareness of culture. Canada is a collection of many cultures each tending to hold to its beliefs. It is the rule rather than the exception to have a human service worker and the elderly person coming from two very diverse cultures further confounded by a professional ethnocentrism on the part of the worker interfering with communication. Ruiz has defined ethnocentrism as "The belief in the validity of one's own ways....A generalized attitude which predisposes an individual to reject members of ethnic and national groups not of his own" (ref 21). From the definition, it is obvious that a person is ethnocentric as a result of basic socialization.

Oftentimes the human service worker is criticized for not understanding the older adult and not being sensitive to cultural differences. However, the blame may be misplaced. There is a lack of leadership and proper preparation programs. Further, resources or services that might be of great help to human service workers in eliminating or reducing concerns are not available (ref 22). For this project, human services were defined as those public and private programs, specifically designed and formally organized to fulfill human needs in the areas of personal growth and development. Human service delivery to the older adult involves a diversity of workers, some of whom are social workers, nurses, activity workers, recreation workers, educators, nutritionists and home care workers to name a few.

PROJECT OVERVIEW

A primary purpose of the Elderly Service Workers' Training Project (ESWTP) was the identification of specific worker needs in their service delivery to the older adults of four ethnic groups;French,German,Native and Ukrainian. The goals of the training project were:

1. To identify and document the problems human service workers encounter in their daily interaction with older adults of selected culture groups.
2. To develop an instructional program for effective problem solving support with regard to the problems identified in purpose number one.
3. To incorporate the uniqueness of diverse multicultural settings in the solutions to identified problems.
4. To develop a foundation of knowledge for both the preservice and inservice training of human service workers who will work with the multicultural elderly population.

The activities of the ESWTP were essentially conducted in three major phases. They are the:1) Research Phase, 2) Development and Testing Phase, and 3) Dissemination and Implementation Phase. The information to the three phases came from a variety of sources. Views were drawn;from a system of voluntary Advisory Committees (Core Advisory Committee, Cultural Task Committees, Content Advisory Committee, Prototype Evaluation Committee);from written surveys of 80 older adult facilities and organizations in Manitoba meeting established criteria, employing 1,787 human service workers; from structured on-site interviews with workers, and;from assessment forms and mailcard surveys of implementation progress and impact at a number of provincial field test sites. They provided a factual and conceptual complement to other available research and assisted the ESWTP invaluably in assessing the validity of its own methodology.

The ultimate outcome was the development of 21 print modules, 12 interactive videotape modules, 9 computer-assisted instruction modules and 4 resource materials. These were categorized in three areas or curriculum blocks.

Block A:Basic Knowledge of the Aging Process (Generic)
Block B:Cultural Gerontology (Culture Specific)
Block C:Work Environment (Generic)

A complete account of all project activities is available in our final report (ref 23).

THE ESWTP AUTHORING SYSTEM

"Intelligent Videodisc Systems" or "Interactive Video

Systems", are just a few of the many existing terms used to describe a common process of reciprocal action between humans and computers and the instructional audiovisual elements displayed sequentially via the television monitor. The successful use of these systems is dependent on the effective application of instructional, computer and video technologies. These technologies were integrated in developing the ESWTP Authoring System employed in producing the project's forty two training modules. In short, the system we have developed required the active participation of all ESWTP staff and close collaboration amongst the project's programmers. It does not require the author/user to have any computer programming skills whatsoever. Used in conjunction with Wordstar-a word processing program available from Microsoft or Micropro, the system can be described as a fully functional authoring system.

THE MODULAR APPROACH

The literature review (ref 24) along with recommendations from inservice educators suggested that the training program should be designed in the form of self study modules that can be used by an individual or by a small group. It was decided that for the purpose of the ESWTP that a module would be an self-contained instructional package designed to cover a single topic. The modularized (print), interactive videotape and computer-assisted instruction (CAI) approaches were selected. This was done after carefully examining some of the characteristics of our clients (concerns,preferences, time and financial constraints), accommodating a variety of staff schedules/sites, and delivery of inservice/preservice activities at almost any time of day or evening.

Each module is cross-referenced, colour coded for ease of identification, graphically illustrated, utilizes humour and is written at a grade 10-11 reading level. Its structure begins with an introduction (rationale), followed by the general objectives/outcomes to be achieved by the trainee. The major content of a module consists of readings, videotapes, cases and related activities. A summary/overview and an appendix of additional readings and resources complete each module.

ESWTP AUTHORING SYSTEM COMPONENTS IN OPERATION

MERLIN, an assembler produced by Southwestern Data Systems in California, proved to be most useful for developing the assembly language programs. The completed system consists of the following components:

SOFTWARE

1. Wordstar word processing software was used to write the modules in the "print format". It was also used for adding the control commands that created a "command format" file which sequences the video and/or computer text segments and flow of control between other courseware segments and disk files.

2. Frame-a video utility program which aids in finding the start and end frame numbers of video segments which are

employed in conjunction with the VIDEO commands in the "command format" file.

3. Compressor-reads, as input, the completed Wordstar CP/M command format file and outputs an Apple DOS text file eliminating Wordstar's control and formatting codes in the process.

4. Interpreter-the newly-created output file is read and presented as text to the trainee along with the compressed command format file. It presents text from the text file, high or low resolution graphics from other files on the disk and audio/visual information from the Videocassette recorder (VCR) to the trainee. The Interpreter's Help Menu also provides a variety of other user inputs which modify courseware flow, thus facilitating self pacing and interaction.

5. Music-a sound utility program for generating music sequences to be played through the Apple's internal speaker, as opposed to the audio tracks available from the videotape.

HARDWARE

The interactive videotape modules utilize an:

1. Apple II+/IIe microcomputer (with at least one floppy disk drive).
2. Video monitor (preferably colour) with speaker for use with VCR.
3. Z-80 card with CP/M (Microsoft or Micropro) for courseware development.
4. VCR (Sony Beta SLO-325) for interactive video courseware development. It is not required for CAI courseware development.
5. Beta format videocassette of module sequences, for use in VCR.
6. Bell and Howell or Whitney interface control card to enable communication between VCR and microcomputer.
7. 80-column display card (several types supported).
8. Various cables to connect the above hardware as instructed in the user's manual supplied with the VCR interface controller card.

Our User's Guide (ref 25) will further direct the reading of interested trainers and educators as they consider, prepare or implement the ESWTP Authoring System.

CONCLUSIONS AND RECOMMENDATIONS

It is our considered opinion that the quality of service, provided to the elderly by human service workers, could be improved through training to effectively deal with the various problems of the multicultural older adult population. Agencies, organizations, and educational institutions servicing the elderly could utilize the multicultural training packages to strengthen their knowledge and understanding of the human service worker-older adult problem dimension.

The following specific recommendations were derived from this project. That provisions be made to:

* Translate all ESWTP products from the Apple II format to the IBM PC format and all print materials into the first language of the workers, in particular Ukrainian, French

and German.

*Facilitate the further development of other human service worker problems in print and interactive video formats.

*Provide support for experimental work in the use of this kind of material on videodisc.

*Conduct experimental research with workers and the ESWTP products. Data obtained from such studies could provide better insight into delivery systems and adult learning.

*Encourage other cultures (i.e.Vietnamese, Chinese, Japanese, British) to be researched and similarly incorporated into a structured training format.

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TECHNOLOGY TRANSFER BETWEEN INDUSTRY & UNIVERSITIES

D.A.Sachs

ABSTRACT

Technology transfer between industry and universities is a complex process. Part of the complexity may be attributed to the different norms at work within the two environments.

For the past year, Pace University's School of Computer Science and Information Systems has been involved in the development and delivery of courses in telecommunications technology in cooperation with a major local corporation. This project, which involved the development of six graduate level tele-communications courses and the work of thirty University and corporate faculty and staff during that time span, has been declared by all to have been successful. The focus of this paper is on the process that transpired: the transfer of education in technology between industry and universities.

As director of this Graduate Telecommunications Program, the author is conversant with all of the issues which occur when one contemplates the transfer of technology between industry and universities, including timing, faculty selection, curriculum development, materials production, and the interfacing of two occasionally disparate ideologies. These topics provide the focus for this paper.

BACKGROUND

In December, 1987, Pace University's School of Computer Science and Information Systems was informed that it had been awarded the contract to develop and deliver six graduate level telecommunications courses to a large corporation located in Westchester County. The corporation was installing its own internal telecommunications network, and needed to teach several hundred people the fundamentals of telecommunications theory. The corporate sponsor wished to offer to its employees six graduate level courses which could be applied toward a Masters In Telecommunications degree.

The corporation had three primary objectives for its employees. They wished to have a curriculum which would:

1) Broaden the ranks of middle management and senior professionals with skills in telecommunications management;

2) Address the tactical issues of operating a private carrier in areas of technical and business functions;

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3) Meet the need for education and professional development for middle level managers and upper level professionals within the corporation's telecommunications organization.

Pace University proposed offering six courses in response to these requests: Data Communications and Networks, Telecommunications Management, Digital Telephony and Switching, Computer Networks, Telecommunications Policy and Environment, and Cases in Telecommunications. The corporate sponsor wished to begin offering these courses in June, 1988.

COURSE DEVELOPMENT

The courses were to be developed by teams, each of which was to be comprised of at least two University professors who would work in conjunction with one or two corporate advisors. The corporate advisors were able to provide professors with access to resources which were timely and oftentimes quite helpful. The six teams were to develop course objectives, student materials, exams, evaluation materials, instructor's guides and all necessary materials for the presentation of these courses to classes which would have approximately 25 students each. The first three courses were taught in June, and the final three courses were taught in August.

CONTENT

A brief outline of the six courses is provided below:

Data Communications and Networks: This course provides an introduction to data communications as a major component of current telecommunications and computer systems.

Telecommunications Management: This course is designed to better equip telecommunications managers with the tools, methods, and perspective necessary to prepare and critically analyze business cases.

Digital Telephony and Switching: This course provides an introduction to voice digitization and switching. The history, development and future of voice technology are presented with an emphasis on understanding the role of digital telephony in such areas as integrated services digital network (ISDN).

Computer Networks: This course develops in detail the concepts and services of networks, including the ISO Reference Model and its layers, and Systems Network Architecture.

Telecommunications Policy and Environment: This course investigates the management problems and public policy issues facing the telecommunications industry as it undergoes structural changes related to deregulation and shifts in government control. An integrated analysis of the financial, economic, technological, social and legal aspects of the telecommunications environment is taught.

Cases in Telecommunications: The issues and tools for planning and implementing telecommunications systems and networks are presented through a major case study. Organizational objectives, as well as legal, financial and management considerations, are all an integral component of the analysis of this case.

EVALUATION

The Graduate Telecommunications Program evaluation process is a comprehensive one which includes:

1) Daily reaction sheets
2) Course reaction sheets
3) Mid-term evaluations
4) Weekly interviews with evaluation teams
5) Evaluation team member logs
6) Student performance in courses
7) Final evaluations

These evaluation instruments provide all of us affiliated with the project with a thorough understanding of the effectiveness of the education being provided, as well as with timely information about student concerns.

ISSUES

Timing: Corporate and university perspectives on time are different. When a corporation decides that it has an important project, money and manpower are deployed instantly to make the project happen. Universities tend to be oriented toward long range planning, committees, and calendars and catalogs that sometimes must be in place a year in advance.

The first issue had to do with the fact that the GTP development work for the first three courses, had to take place while the Spring semester courses were being taught. This meant that scheduling meetings became quite complicated. In addition, a wonderful University professor was unable to continue working on the project, due to his already full set of commitments prior to the onset of this program.

Also, it is probably fair to say that many university professors have a somewhat more relaxed attitude towards time than do their corporate counterparts. Consequently, this author spent much of the Spring of 1988 trying to keep faculty members "on time" with regard to the development of course materials. At moments this seemed like an overwhelming task!

Curriculum Development: Most university professors are accustomed to developing curriculum on their own. Typically, this means that a course textbook is selected and then a set of "lecture notes" is prepared. In this instance, since the corporation had a strong interest in the courses which were to be taught, a great deal of attention was paid to the goals and objectives for each course. For some of the professors this was an unfamiliar and perhaps uncomfortable experience.

In the University, professors might have a year in which to propose and develop a new course. In this setting, we had (at most) six months, and for the first three courses to be developed, significantly less. Materials had to be developed (well) in a substantially shorter time span than was normally the case. Also, since we were working in conjunction with corporate advisors, ample time had to be allowed for them to read, review and respond to the materials.

Materials Production: Typically, university professors do not spend enormous amounts of time preparing professional quality materials for their courses. However, corporate expectations are different. The norm within many corporations is for information to be presented in a professional manner, using overhead transparencies.

For this project, it was clear that all of the materials would have to be developed using graphics software. For several of the professors, this again meant that there was a new way of doing things, which added time to the curriculum development process as well as additional work.

Evaluation: For some of the professors, this was a new, and in some cases, uncomfortable process. Their teaching, which is normally a rather private activity, had become a public one. Not only was the teaching subject to the feedback of the students, but this feedback was public information. Those of us involved in the supervision of this project, were given immediate access to this information, as were the professors involved. When the feedback was good, it was wonderful. But when the feedback was less than laudatory, it became quite complicated.

CONCLUSION

The Graduate Telecommunications Program has been an exciting one for all concerned. Faculty members have had the opportunity to participate in an exciting educational experience. Many of them have commented about how much they have learned during the past year about telecommunications, curriculum development, evaluation, and other issues. In addition, it has given some of them a "real world" set of corporate friends who are actively involved in the dynamic world of telecommunications.

It is fair to say that the transfer of educational technology between industry and universities is a complex process. It entails a great deal of hard work, a good sense of humor, and the willingness to compromise. But the rewards are profound for all involved, and well worth having.

INFORMATION TECHNOLOGY TRAINING NEEDS OF NON-TEACHING STAFF IN ACADEMIC INSTITUTIONS

A P Broadaway*, F Donahue**

ABSTRACT

The introduction of computer based techniques into all academic disciplines means that the knowledge needed by staff to effectively utilise these techniques must continuously evolve as the techniques evolve. Whilst there is a certain amount of staff development activity for academic staff, there is little evidence of a systematic and comprehensive staff development provision specifically for non-teaching staff (or educational support staff).

In order to influence and contribute to change to ensure the success of work related education funding, there is a need to consider the dynamic environment in which non-teaching staff now find themselves. Recognition of this changing and enhanced role in curriculum development activity will maximise the opportunity that work related planning represents, and improve the responsiveness of an institution to local and national demands.

INTRODUCTION

In 1988 a pilot programme of a systematic and unbiased collection, organisation, and analysis of the changing demands on non-teaching staff as they relate to information technology developments throughout all disciplines, was undertaken. This was followed with an overall identification of training needs for such staff, and finally the type of training itself described.

The work undertaken was unique and the findings of the study are such that detailed classification and local embedding of the necessary training requirements will have a significant benefit to academic institutions.

Further funding was obtained in 1989 to build on the findings and produce in depth classification and training needs analysis of areas related to information technology in all its broad forms (including management information systems) for non-teaching staff, and to evaluate the results by local embedding and implementation within the Northamptonshire and Bedfordshire Local Education Authorities (LEA's), of the United Kingdom.

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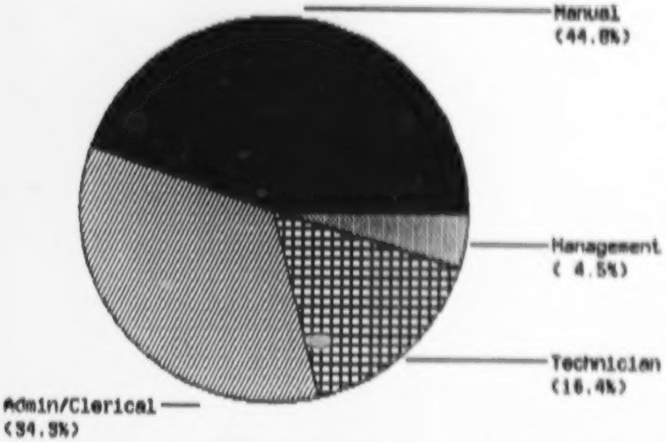
STAFF PROFILE

The Northamptonshire and Bedfordshire LEA's are responsible for 9 Further Education Colleges which provide full time and part time education and training for persons over compulsory school age. Also within the Counties are 2 Higher Education institutions. Complementary to the academic teaching staff of each institution, are a set of people whose numbers can exceed those of the teaching staff and whose occupations can be broadly classified into 4 major groups: administrative/clerical; technician; manual; and academic management.



Analysis of staff at Nene College, Northampton

Total number of staff = 335

WORK RELATED NON ADVANCED FURTHER EDUCATION

In response to guidelines issued (1985) by one UK Government Agency, the Manpower Services Commission (now the Training Agency of the Department of Employment), each LEA has to determine a three year development plan of activity which is responsive to local labour needs and also is cost effective. The several Government schemes relating to the use of computers in education eg Microelectronics Education Programme, Education Support Grants etc were concentrated on teaching staff, but there is now growing recognition and acceptance of the changing and enhanced role of non-teaching/educational support staff in the curriculum with improved access, a wider clientele, changes in teaching and learning strategies, new technology and marketing all placing demands on these staff.

JOB RESPONSIBILITIES

Warner (1984) identified some obvious examples of how support staff make an effective contribution to curriculum development, and also asked about the question of responsibility in an institution for:-

Students: admissions procedures - enrolment - registration with validating bodies, examination administration, servicing Examination Boards, issue of certificates - student records (computerised or manual);

Finance: estimates, budgetary control, invoices, inventories, collection of tuition/examination/registration fees, student union funding, grants, travelling expenses, etc;

Staffing: control of teaching and non-teaching establishments, advertising and appointments, part time lecturers' contracts and payment;

Catering: refectory, halls of residence;

Buildings: maintenance, caretaking, cleaning.

Other tasks performed by this group include telephone and mailing lists, car parking, profiling, careers guidance, conferences, health and safety, absence analysis, communications, credit control, investment management, grounds, consumable and equipment purchase, inventory and maintenance, vehicles, and also for the non-teaching academics the management of the institution.

COMPUTER DEVELOPMENTS IN EDUCATION

To meet the changing needs and demands of an academic institution, it is necessary to take full account of the dynamic nature of the computer based technology involved, and ask "What can the technology do for our support staff?" The computer by being educationally neutral, has by appropriate choice of software and techniques, been used to support different educational philosophies. Rushby (1984) summarised this spread of different approaches with four paradigms:

- instructional eg drill and practice
- revelatory eg simulation
- conjectional eg testing by hypothesis
- emancipatory eg reducing tedious workload

The emancipatory mode - computer as a tool - contrasts with the other three modes - computer as a focus. As a tool, the thread of activity is independent of the computer even though it is extensively used. This is the mode primarily encountered by support staff.

FEASIBILITY STUDY

An evaluation of needs of one institution was undertaken by (i) questionnaire to all educational support staff (ii) follow up interviews with managers and (iii) visits/talks to other institutions. From these a specification of needs was determined with the most basic concept that staff require training on hardware, software and systems they use in their day to day work rather than broad educational concepts. They do not want to go away to a centre, be given the theory, illustrative examples etc and then be asked to go back and apply the principles to their work. The type of skills requirement analysis identified word processing to be the highest, followed by databases then spreadsheets. The response rate was interesting, but on reflection not surprising.

	Clerical	Technical	Manual
Issued	112	54	144
Returned	70	21	10
Response Rate	62%	39%	7%

Questionnaire Response Rate

Consideration of issues such as open learning (no significant demand), equal opportunities (no discrimination found), trade union reaction (supportive but vary) were also looked at along with the obvious topics of level, type, format and content of training.

SKILL LEVEL

Consideration was given to the concept of determining a minimum level of skill for each job or scale. It was found that this would be too contentious an issue to implement without full and careful consideration and discussion and to impose conditions on staff already in post would cause a lot of bad feeling. Nevertheless it is considered that this system is needed and could be phased in gradually at times of staff change with the new employee having appropriate standards included in the relevant job description/conditions of service.

RESEARCH AND DEVELOPMENT PROJECT

Building on the foundation of the feasibility study, further work is now underway for the in depth classification, needs analysis, local implementation and evaluation of IT training needs for non-teaching staff. Working with an adjacent LEA a unique way to progress was determined. Recognising the need that the staff want specific job related training in information technology, a DACUM (Developing a Curriculum) approach is being used. The DACUM process involves the analysis of current occupational skills by bringing groups of role holders (staff) and their immediate supervisors together to produce lists or charts of duties of tasks which make up the named occupational role. The product of this activity is then used to determine modular competency based schemes which are relevant and motivating to the learner.
In North America there has been wide use of DACUM to develop curricula, but only limited use has been made in the UK to date.

APPROACH

The initial approach will be to take 2 people from each institution from each of the 4 groups of support staff previously identified. The people selected are considered to be key staff for swift results and provide appropriate representation, responsibility and influence. Following the DACUM analysis, an IT specialist working with an IT trainer in each institution will (i) identify where information technology can enable the task to become more efficent, (ii) design an appropriate training module which will if possible be linked to the developing role of the UK system introduced by the National Council for Vocational Qualifications (1987) and (iii) deliver the training at the institution again working with the designated trainer.
It is anticipated that a notional 40 hours for each training module will be required.

OUTCOME

The outcomes will be many and various. The most significant are identified at this early stage as:

- a series of tested training packages suitable for national use;
- recognition and development of a strategy for the IT training needs of non-teaching staff;
- implementation of these needs by having a certain number of staff undergoing the training;
- evaluation of the needs to provide a tested framework;
- recognition that staff training is an integral part of individual performance development and appraisal;
- production of guidelines for national use;
- publications describing the approaches adopted and best practice found;
- an evaluation of the increased effectiveness, efficiency and responsiveness of institutions to the needs of the local labour markets.

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TECHNOLOGY, TRAINING, AND OBSOLESCENCE

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Abstract

Traditional organizational lore has suggested that the rapid influx of technology has increased worker obsolescence, a condition which must be ameliorated by investments in training. Recent research suggests that there is both support and disconfirmation for this truism. An alternative conception of the relationship between technology, training and obsolescence is needed if we are to maintain a productive workforce in the light of these changes. Continuous learning and learning how to learn skills will characterize the new approach to training.

The Problem

A recent fact sheet on retraining (ref 1) asserts that foreign competition, new technologies, and changing consumer demand have reshaped the job market in such a way that Americans can expect to change jobs three and four times in a career. Moreover, seventy-five per cent of all workers currently employed will need retraining because of changes in the nature of jobs or the creation of new jobs. Since seventy-five per cent of those who will be in the workforce in the next decade are already at work, retraining may be the only option if we are to have a skilled workforce.

Arguing that the cost of dislocating workers without providing retraining is a human capital cost that this country cannot afford, Perelman (ref 2) states that "economic security in the post-industrial economy depends less on expertise and more on flexpertise, the ability to continually adapt individual knowledge and skill. Unless we in America greatly increase the flexibility of our human capital, the economic transition threatens turbulent, even violent, social upheaval as the economic ambitions of a major protion of the working population become increasingly frustrated." Perelman makes a dramatic case for retraining as he asserts "Virtually the entire adult population needs retraining and new learning to be economically productive. A fifth of the present adult population is functionally illiterate. Most of the rest, including skilled workers, managers, and professionals, have knowledge and skills that technological change is rendering obsolete."

Not all researchers agree. Lillith and Tan (ref 3) conducted a major research study for the Rand Corporation to determine the effects of private sector training on long term earnings and employment. A subsection of their research was to examine the relationship between technology and obsolescence. They note that the former concern over worker displacement by technology has been replaced by a concern about the need for new skills. They argue that many job-relevant skills are technology-specific and are acquired through working with particular technologies. Thus in-house training is more likely to predominate in high technology industries, and this training is most likely to go to the highly educated. Lillith and Tan felt that their most novel finding, however, was that there does not appear to be a relationship between technological change and unemployment. In fact, in their sample of male youth, a higher rate of technological change was correlated with a lower probability of unemployment. Overall, they

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found that "As the rate of technological change quickens, the probability increases of getting managerial training and training from in-house sources..." This is especially significant since in the larger study, the single most important determinant of long term earnings and employment was employer-sponsored training, an effect that persisted over 13 years!

Others have suggested that although automation may eliminate many jobs, almost two-thirds of the jobs that existed 100 years ago have been eliminated and yet over three times as many people are at work today. Projections for the year 2000 indicate that computerized automation will permit us to produce the same amount of goods and services that we do now with ten percent fewer workers, yet more jobs will exist (ref 4).

Rumberger (ref 5) says that there are two myths about high technology--that it will be the primary source of jobs and that it will vastly upgrade skill requirements. Rather, most new jobs will not be in technology and only a small portion of the workforce will be employed in high technology industries. Moreover, automation and robotics will lead to reduced skill requirements for more and more jobs. These findings lead to the need to redirect education toward lifelong recurrent education, stronger basic skills, and toward the encouragement of adaptability and flexibility in workers. Mid-level jobs will also be affected by high technology. There is some evidence that these jobs will be "highly susceptible to displacement or deskilling because of the introduction of robotics and various information technologies" (ref 6).

Smith and Smith (ref 7) note these responses to technological change and argue that these changes in the organization of production processes in large firms and the increased emphasis on interchangeability and flexibility in small and medium-sized firms are eroding the efficacy of the concept of occupation. The concept of a stable set of skills carried out in a variety of companies or contexts is no longer viable. Increasingly individuals are being asked to acquire discrete sets of job-specific skills in order to respond to ever-changing requirements in their workplace. As individuals move through their work years, they will need many different sets of skills, whether or not they stay in the same company. They note that in Japan, the employer remains your employer for life, and your obligation is to continually acquire the skills that employer needs of you. In order to make this move possible, Smith and Smith call for training centers by industry which provide competency-based skills training for numerous jobs and to which all companies in an industry can send their employees as often as needed to update their skills.

In each of these analyses of the problem, the central role of training and retraining in meeting the changing demands brought on by new technologies is emphasized. Yet, federal initiatives to retrain workers have proven inadequate. Complicating the issue is the fact that federal efforts have predominantly been aimed at employing the hard to employ people who are either illiterate, disadvantaged economically or in other ways, long term unemployed, etc. Few would disagree that retraining individuals for new occupations, especially in technical fields, is greatly hampered by the inability to read. Long term unemployment and low levels of education are consistently correlated with future unemployment. Moreover, there is considerable disagreement about who should pay for retraining. Federal efforts have been directed toward training those who swell the relief rolls. Unions, on the other hand, are beginning to successfully lobby to have retraining provisions as part of their union contracts. The United Auto Workers negotiated a five cent an hour deduction from Ford employees' wages to help finance the national development and training center in Dearborn (ref 1). Some professional level workers have sought professional training as a recurring part of their "knowledge maintenance." Promoting lifelong education among technical and professional level employees has resulted in organizations such as hospitals requiring continuing education of their employees at that employees' expense. Some states have even required continuing professional education for continued certification. In other instances, this professional updating has been an obligation that the the employer was willing to assume. The Canadian Commission of Employment and Immigration (ref 8) called for paid educational leaves to be provided by companies as a response to the need to update and retrain individuals. Similarly, Bendick and Egan (ref 9) point to the French approach to mobilizing public and private resources to provide for midcareer worker retraining as an approach to our own concerns about worker obsolescence.

Training Responses

Whoever pays for retraining, the cost will be significant. Yet the cost of allowing three-fourths of our workforce to become obsolete is considerably greater. One approach to worker retraining has been advocated by the Work in America Institute, the Continuous Learning Model. In it, everyone in the organization is engaged in learning new skills. In this model, employees are active participants and learning is an everyday part of the job, not a special course or workshop. Employees share knowledge with each other, both learning from and teaching others. They are also encouraged to master not only their own job's skills, but those of the others on their work team and to learn how their job fits into the overall scheme of things in the work unit and in the organization as a whole (ref 10). This low cost concept based on an each one, teach one training model requires a radical restructuring of work.

There is an even more dramatic restructuring required if training is indeed to be successful in addressing the problems of worker obsolescence. Ripple (ref 4) writes that "No longer is it sufficient to teach people to earn a living. Rather, they must be taught how to learn a living. . .In addition to learning subject matter in schools, students must learn how to learn." Smith (ref 11) finds that computerized technologically advanced machines are not transparent, thus the operator must be able to "read" what is on the screen and know what it means in terms of the operation of the machine. These skills she calls knowing how to learn technical knowledge. These higher level learning or "literacy" skills must become the heart of retraining efforts. Such a transformation will ask individuals to take a long term, broader perspective on their work, their work/life transitions, and to test the limits of human malleability. When machines can no longer adapt, they are replaced. With the workforce of the 1990's already at work, perhaps the greatest challenge of American technological ingenuity will be whether or not we are able to develop approaches to learning which allow individuals to become more adept at making the many changes demanded of them in this era, for these people cannot be replaced.

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TECHNOLOGY AND EDUCATION IN A COMMUNITY CONTEXT 'BREAKING DOWN THE BARRIERS'

Dorothy Dalton*

ABSTRACT

The nature of the barriers preventing access to education by many people in the community will be examined in this paper. The crucial role of new information technology in helping to bridge the gap between formal and informal education in order to break down some of these barriers will then be explored. The paper will seek to illustrate how this operates in practice in Scotland. There will be three main themes.

1. An outline of current practice, showing the benefits to all of links between school and community; college and university and the community, as well as the voluntary and public sectors, concentrating on how technology can be used to provide a better learning experience and innovative educational opportunities.

   The key role of the Community Education Service will be examined in some detail.

2. An examination of how inter-agency co-operation between support organisations can stimulate and promote developments in the field. In particular, the paper will look at collaborative work by the Scottish Community Education Council and the Scottish Council for Educational Technology, via the Community Education and New Technology Group of practitioners. Examples will include joint software development, software distribution and training.

3. The international sharing of ideas and methods is crucial to the development of all education, but especially in the fast-changing world of new information technology. The paper will examine the role of organisations such as SCEC and SCET in co-ordinating exchanges, study visits and conferences to encourage this process.

1. INTRODUCTION

Scottish education is funded partly by Central Government and partly by local property tax. The system is run by local government regions whose educational responsibilities include School, Further Education colleges, careers guidance, pre school, and my special interest Community Education. Everyone knows what a school is, but Community Education is more difficult to explain. The service brings education in the widest sense to people where they live in their own communities. It employes Community Education Workers, whose tasks include working along with local people in their area on youth work, community interest topics and adult education. In Community Education you try to work yourself out of a job and encourage all your people to become self confident in their own life and better able to play an active part in the life of their community.

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Community Education is a process that affects all age groups, although there has always been a special emphasis on those whom school did not serve too well.

Community Education begins where people are and it does this in three ways: it makes them aware of educational opportunities and how these are relevant to them; it develops practice that's sensitive to what people need and want; it involves people in creating and managing their own facilities and services, whether it's the lunch club for the elderly, a youth club, a community centre or a village hall.

My organisation is the Scottish Community Education Council. We provide policy and resource back up to everyone in Scotland in community education. I am also a missionary trying to convert others in education to our ways of thinking and working.

SCEC is a quasi governmental organisation which means that we can vary our nearness to government depending on circumstances. Today, the distance is approximately 4,000 miles, sometimes it can be less!

2. BARRIERS TO LEARNING

Many people in the community face barriers to learning which prevent them taking advantage of courses and opportunities which would help them improve their situation. Family responsibilities, disability, lack of confidence, language problems, lack of money, lack of access and learning difficulties are some of the factors which can prevent access to education. Certain groups are especially vulnerable, including unemployed people, disabled people, women, and some from ethnic minorities. In Scotland, Community Education exists to break down these barriers, enabling people to help themselves.

New Technology has an extremely important role in assisting community education workers in this task. This paper gives some brief examples of good pratice in Scotland. These illustrate how co-operative ventures between community education and others using new technology can be of benefit to all - formal and informal educators as well as 'end users.'

3. EXAMPLES OF GOOD PRACTICE

3.1 LOTHIAN REGION - Whitburn redundant workers group

Whitburn is a small town outside Edinburgh. The major employer in the area was a car manufacturer, British Leyland. When the factory closed after 25 years it had a devastating effect on the local economy. Community education together with other agencies, took every step they could to try to alleviate the effects.

A good example is the work undertaken with the Whitburn redundant workers group. Community Education carried out a survey to establish what this group of men in the 45+ age group wanted to do. The result was a programme of activities. New technology was one of the subjects identified by the group. Community education then acted as the link to establish computer courses for the group in Whitburn Academy, the local secondary school. Teachers stayed on after school to run the courses which led to a nationally recognised qualification (a SCOTVEC Module 'introduction to computers'). Some of those who completed the original courses are now following up with other activities at the school.

3.2 BORDERS REGION - Newton Primary School

At Newton Primary School in rural Borders Region there are very close links with the community. The school's community wing is extremely busy with groups ranging from playgroups to adult education classes making use of the facilities.

The use of new technology forms a key part of this linking. The Headteacher at the school, has set up a computer-based community information system using a viewdata package already in use in the school. The information system is housed in the community wing on a computer which is fully compatible with the equipment in the school. Users are able to find out what is on in the community wing, contacts, special events and details of the various groups which use the wing. The Headmaster believes that this is only the beginning and hopes that other software currently in use in the school can be adapted for community use.

3.3 HIGHLAND REGION - Electronic Job Link

Highland Region covers a large rural area with a scattered population. This means that unemployed people are especially disadvantaged, as it can be very difficult to find out about job opportunities. The Training Commission, the government agency concerned with job vacancies is involved in an innovative project with community education to help overcome these problems.

The Training Commission office in Inverness supplies details of jobs which are then beamed 'down-line' and displayed on viewdata terminals in community-based locations such as community centres. The system is interactive - users are able to order information in the form of leaflets and listings. If they are interested in a particular vacancy, they can pick up the phone attached to the system and are linked straight through to the Job Centre. The system also holds local information such as details of courses run by the Community Education Service and lists of events at community centres.

3.3 TAYSIDE REGION - Community-based computing specialist

Ron Smith has a highly unusual job - he is the only computing specialist directly attached to a Community Education Service in Scotland. Based with the Research and Development Team of Tayside Region, Ron is viewed as a community resource. He offers training to community groups, sets up systems, acts as a consultant and develops software.

When members of Mauchline Tenants Group in Dundee undertook a nationally recognised course on contemporary issues involving research into housing matters, they asked Ron for assistance. He helped them to design a questionnaire, set up a database and provided training on how to input and process the information. He also advised on the best method of presenting their findings. In addition to the training provided by Ron all of the Group successfully completed their course. He has also run courses in computer programming for unemployed groups and done a great deal of work in support of Adult Basic Education.

3.4 FIFE REGION - Computer Aid

In March 1988 Fife Region launched Computer Aid, a pilot project aimed at helping unemployed disabled people 18+ to find work by enabling them to develop new computer-related skills such as word processing, programming and keeping financial records.

The course was run by the Special Needs Department of Glenrothes Technical College and ran for 13 weeks with funding from the European Social Fund. Each student was given a computer to work on at home. They were supplied with a series of modular packages to work through with the help of a tutor who visited once a week. Each student had a phone line connecting them to the college in case they required assistance.

4. AT NATIONAL AND INTERNATIONAL LEVEL

Scottish Community Education Council and Scottish Council for Eductional Technology are collaborating to ensure that those involved in community education in Scotland are fully represented and up-to-date with developments in the fast changing world of new technology. This has led to the setting up of the Community Education and New Technology (CENT) Group which contains representatives from community education in each region in Scotland, as well as the voluntary sector and SCEC and SCET.

The Group is concerned with all aspects of new information technology as they apply to community education. Major areas of interest include software development and adaptation; on-line databases; training; and video, interactive video, satellite and cable.

It is crucial that collaboration at local and national level is augmented by the international sharing of ideas and methods in order that everyone can benefit and learn from good practice in other parts of the world. Organisations such as SCET and SCEC have a major part to play in co-ordinating exchanges, study visits and conferences to encourage this process. In an increasingly technological world it would be easy for a group in society with none of the skills for the new technologies to emerge. Such a group would become increasingly alienated from the rest and would be left behind in the future, lacking both work and life skills. Our various projects and plans will help to ensure that this will not heppen.

TECHNOLOGY LITERACY: A KEY TO THE NEW BASIC SKILLS

Richard "Buzz" Brown

ABSTRACT

A historical background shows the need for technology literacy in todays' workforce. Technology literacy is defined as the missing link between basic skills instruction and machine-specific training. The thinking pyramid model is proposed as an effective method of problem-solving in technology training. The qualities that make a person technologically literate are enumerated; special emphasis is given to an examination of problem-solving and teamwork skills. Finally, there is a summary of a pertinent current debate: Is the private sector or the public sector responsible for technology literacy training?

INTRODUCTION

My objectives today are to:

- Define the new basic skills — key among them technology literacy
- Increase your understanding of what is entailed in technology literacy training that distinguishes it from other sorts of literacy training
- Define the role of that training in producing an economically competitive workforce
- Provide an example of an approach that works to address the new basic skills training with an emphasis on technology literacy training

To understand how a technologically illiterate workforce impacts the economy of the United States, consider the comments made by Dr. Lester Thurow at a recent conference of City Managers. "At the end of World War II we were 75% of the World GNP. As late as 1960 we were 50% of the World GNP. Today we are just 23% of the world GNP. If you think about what is the competitive edge that any country has, it's something that's under your jurisdiction. The thing about which we compete [in the world] is, What's the quality of the local workforce in terms of education and skills? . . . if you look at the education and skills of our workforce, we just don't match up very well."[1]

In the nineteenth century, during the Industrial Revolution, the United States experienced rapid growth and became the leading industrialized nation in the world. The availability of an educated workforce proved to be an important aspect of that success. Consider the following analysis of American industry during the 1850s:

"A fourth reason offered by British observers to explain American economic efficiency was an educational system that had produced widespread literacy and 'adaptive versatility' among American workers. By contrast a British workman trained by long apprenticeship 'in the trade' rather than in schools lacked 'the ductility of mind and the readiness of apprehension for a new thing' and was 'unwilling to change the methods which he has been used to,' according to an English manufacturer."[2]

Compare this observation with a recent statement made by Former U.S. Secretary of Labor William Brock: America needs an educational system with "much more emphasis on flexible training that allows people to adapt to technologies as they constantly change around them in the work place."

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[1] Excerpt from The Zero-Sum Solution, delivered at the 73rd Annual Conference, International City Management Association, Montreal, Canada, October 25-28, 1987, Lester C. Thurow, Professor and Dean, Sloan School of Business Administration, Massachusetts Institute of Technology.

[2] McPherson, James M. , Battle Cry of Freedom, The Civil War Era (New York: Oxford University Press, 1988), pp. 18-19.

This remark has been hailed as innovative and visionary but we can see it is simply returning to the educational precepts and values that were originally responsible for America's industrial development. What is required of America's educational system today?

I frequently hear discussion as to the purpose of education. Should education respond to business pressures and prepare students for specific jobs or should education prepare students for the future in which they will live? Alan Bloom in *The Closing of the American Mind* observes how "A highly trained computer specialist need not have had any more learning about morals, politics or religion than the most ignorant of persons." Those believing education should provide a more liberal arts background should take note of the recent statements made by industry leaders. It appears the ultimate goal of educators and industry's perceived need in its entry-level workforce are merging. David Kearns, Chairman and CEO, Xerox Corporation stated, "Indeed, the last thing Xerox and other high-tech companies need is vocational education. We need employees who are broadly and deeply educated, men and women who are "liberally" educated."[1]

I am concerned that Kearns' statement regarding vocational education is an example of a polarization which is occurring in the education field. Compare Kearns' comment with one made by Charles H. Buzzell, Executive Director of the American Vocational Association, "Reading the popular press, it is easy to come away with the feeling that traditional vocational education programs are no longer appropriate at any level. . . . What absolute nonsense! Contrary to what some would say, employers large and small expect us to prepare students to arrive on the job ready to be productive."[2] I believe both gentlemen are correct, we need a vocational education system which delivers the new basic skills industry needs, but in an applied technological setting, and we need the general education system to adopt creative instruction in applied math, physics, and science.

The New Definition of Literacy

We must put into perspective the "widespread literacy" which the British observers identified in the United States during the 1850s. At that time, the commonly understood definition of **basic literacy** was being able to read and sign your own name. That notion was followed by a definition of **simple literacy** which included being able to read and comprehend short sentences. Brock's suggestion that we graduate workers who can adapt to technologies as they change around them in the workplace requires a much higher level of literacy than was found in the "adaptive versatility" of the American workers in the 1850s. This level of literacy is referred to as **functional literacy**.

Functional literacy includes the basic academic skills as well as knowledge in the areas of personal and interpersonal skills, communication, comprehension, quantification, critical thinking, and technology literacy skills. In addition one must be able to apply those strategies that permit individuals to adapt information and skills for use in unfamiliar as well as familiar situations and contexts.

In the past, this combination of skills was seen as representing two distinct levels of skills — basic and higher-order. Today both skills are necessary. Together they will be referred to as the new basic skills, skills required for jobs we traditionally considered lower-level.

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[1] Kearns, David T. & Doyle, Denis P., Winning The Brain Race (San Francisco: Institute for Contemporary Studies, 1988), p. 4.

[2] Buzzell, Charles H., "Job-specific Skills: A Renewed Commitment," Vocational Education Journal, August, 1988, p. 8.

Our experience with today's American workforce suggests that effective technological training must have three components: *basic skills* training (reading comprehension and math skills), *machine-specific* training, and training to bridge the gap between them. This intermediary training is *technology literacy* (front-end training).

Basic Skills (Reading & Math) — Technology Literacy (Front-End Training) — Machine Specific Training

Analysts have identified the lack of both basic and technology literacy training as a major problem in successfully implementing automated manufacturing. Roger Smith, chairman and chief executive officer of the General Motors Corporation, admitted that GM has to implement more "upfront education and training of our workforce before high technology is introduced."[1] A two-year federal study commissioned by the National Academy of Engineering and released on June 17, 1987, also identified the lack of technology training programs.

The comprehensive objective of technology literacy training is to produce workers who do not have to be "retooled" as technology changes. Such an outcome provides greater use of existing human resources, and also brings the most effective return on expenditures for training resources.

To achieve this objective, we need a new way of thinking about learning. Because technology will continually change the worker's job, the worker will have to master new information and skills continually as well. Our concept of training must also move beyond that of training workers in single, static skills to one of preparing workers to function in complex, ever-changing environments.

The ACTT Approach to Learning

ACTT's technology literacy curricula and methodology was developed by an international non-profit organization based in Geneva, Switzerland and London, England. The organization is called ORT (the Organization for Rehabilitation through Training). ORT is over 100 years old and to date has retrained over 2.5 million people in 48 countries worldwide. The curricula have been implemented by several countries in Europe and South America, and Israel. Most recently, ORT signed a letter of intent with officials of mainland China to implement two technology literacy pilot sites. ACTT is the North American licensee for ORT's technology literacy curricula and has adapted the material for use in this marketplace.

ACTT's technology literacy training is based on a classical educational model of how human beings reason called the "thinking pyramid." This model produced a design for technology training that goes beyond skills and procedures to prepare workers to respond to changes in their working world.

The thinking pyramid epitomizes problem solving. We move up, down, or around the levels of thinking shown on the faces of the pyramid, with the back faces representing different, but related, topics. In problem solving we move upward from concrete data to work out procedures, form theories, and draw abstract conclusions. We move back down to more concrete thinking when we consolidate information, apply it to a problem, and test our solution. When we teach people these analytic skills along with, and applied to, technical information, they learn to solve existing, as well as new, problems by using their own internal problem-solving resources.

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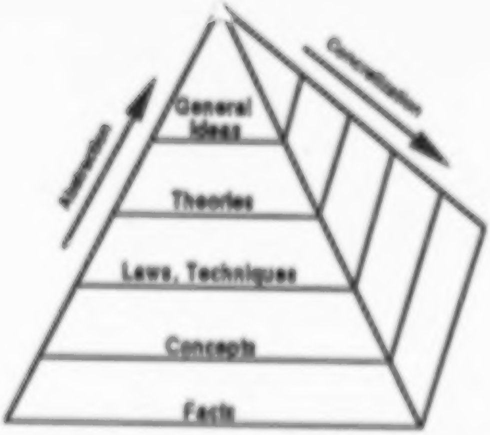
[1] "GM to Change Development Of Technology," The Wall Street Journal, July 28, 1986.

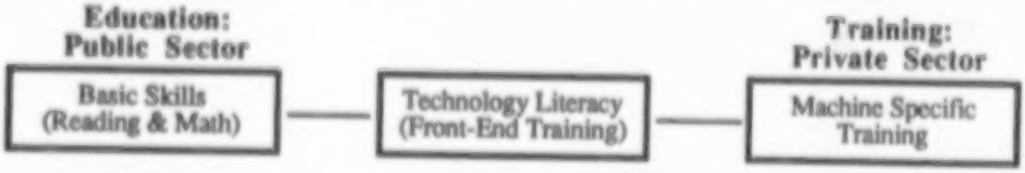


Educators are frequently criticized today for teaching just facts. Ironically, a primary objective of our front-end training is to graduate workers who can learn from facts and apply those facts to new processes or machines. By graduating workers who are comfortable with moving up and down this learning pyramid, you are graduating workers who can digest facts and require significantly less on-the-job training each time new machines or processes are introduced.

Public or Private Funding

The final issue to discuss is the funding source for technology literacy programs. Is this kind of training an extension of one's basic skills and therefore the responsibility of the traditional education system? Or is this training job related and therefore the responsibility of the employer to provide?

The three-box model described earlier shows easy solutions for the left and right boxes. Most people are in agreement that the box on the left is called "education" and the public sector of the economy is responsible for its funding. The box on the right is called "training" and the private sector (employer) is responsible for its funding. The box in the middle is not as easy to describe. To some it is personal enhancement and to others it is job-related.



The skills included in the characteristics of a technologically literate person are skills which should be mastered upon graduation from high school. However, as long as we are dealing with a current workforce which is deficient in these skills, some form of joint partnership must be developed by industry, government, and the individual, to provide this training.

We can see the importance of a technologically literate workforce on the American competitiveness. It is up to all of us to explore new ways with which to achieve our goal of a technology literate America. Only through cooperation among the various segments of the public and private sectors can we truly succeed in the monumental endeavor.

RETRAINING THE TRAINERS

Robert A. Lapsley *

ABSTRACT

In the past, the emphasis on technical education has been on craft studies and consequently, most teachers of this subject have little or no experience in electronics. The piloting of Technological Studies has however, given a few technical education teachers an opportunity to teach electronics.

Based on operational experience, this paper defines and details the methodology of the retraining programmes and highlights the crucial role of resource implications, with particular reference to hardware and software applications.

INTRODUCTION

In our industrial society a healthy economy is highly dependent on the intelligent and efficient application of new technology. It follows, then, that in order to maintain this objective, a constant supply of skilled engineers and technicians is essential. Experience has repeatedly shown that society cannot solely rely on the self-motivation of aspiring professionals, to meet the necessary demand. Therefore it becomes increasingly imperative for the secondary education sector to generate sufficient stimulus, influencing pupils at an early stage and so ultimately effect a greater social awareness of technology.

The school curriculum does not, by and large, reflect the overiding fact that we are an industrial nation; neither does it reflect the intellectual demand for the application of knowledge. The government's success in placing microcomputers in every school is turning out larger numbers of low grade Basic programmers but precious few students who can handle electronics at "chip level". Even the MSC/ET information technology programme is aimed at producing people who can operate computer numerically controlled machine tools or computer based office systems, rather than design or service equipment.

Historically, many subjects within the school curriculum have already dealt with technology in one way or another. However, the inclusion of Technological Studies is intended to develop, in the pupils;

i) An understanding of technology within an industrial and commercial context.

ii) An appreciation of the flexible and adaptive work ethic.

Current industrial design and manufacturing technologies are of such complexity, that products are constructed from interconnected components, with few individuals knowing more than the function of each part. Consequently, industry sees a product as a system fabricated from a series of sub-systems with input and output functions as important features.

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* University of Stirling - Engineering Degree programme

Thus Technological Studies requires pupils to derive practical solutions to problems through the application of a systems approach. Emphasis is placed on problem solving based on the application of relevant knowledge only, and in particular, training to expand tasks in a logical manner. Electronics is a useful means of introducing young people to the methodology of technology. The traditional approaches of scientific study have been directed to the investigations and understanding of the "how" and "why" questions. While the reasons for the scientific community favouring this approach can be appreciated, it no longer reflects present industrial methodology. It is not so much 'why' and 'how' something works, but "what it can do?" Consequently the "black box" approach to complex systems enables pupils to solve industrially relevant problems. It has been declared that the course in Technological Studies should therefore fulfil the following aims:

i) to encourage the acquisition of problem solving skills
ii) to develop the pupil's ability to apply the systems approach to practical problem solving
iii) to allow pupils to comprehend the evolutionary nature of technology and to recognise the effect of technology on the quality of life and the environment.

In attempting to address the immediate issue of providing sufficient numbers of competent technology teachers, a recommended structure for In-Service retraining courses has been proposed.

Resulting from detailed discussions within the Department of Education - University of Stirling, local authority Education Advisers and nominated interested parties, proposals were initiated which represent a programme of study in line with the Three Tier structure philosophy of the Scottish Education Department. This creates a more flexible programme by virtue of its credit transfers schemes and thereby offers inherent attraction to the education authorities.

Proposed Programmes

A set of 19 units, intended for technical teachers wishing to become teachers of Technological Studies, was presented, for which, students must aggregate credits to obtain:

i) a Certificate - 6 units
ii) a Diploma - 14 units
iii) a General Degree of BSc - 18 units

Most technical teachers do not have a degree and there is no route in Scotland for them to obtain one, other than by undertaking an Open University Degree or the Stirling BA in Education Studies (or its equivalent). It is considered that neither of these approaches is particularly appropriate for technical teachers. Thus the design progression from Certificate through Diploma to Degree competently addresses the increasing desire for technical teachers to aquire degree status.

The proposal is designed around 30 hour units, which accommodate the school term. Each of the units requires additional personal study and contains a substantial element of assessment.
Units are offered at two levels.

Certificate Level
Introduction to Information Technology and microcomputers.
Introduction to Systems Electronics.
Digital Electronics.
Introduction to microcomputer control.
Pneumatics.
Technology and Manufacture.

Diploma / Degree Level
Teaching Technological Studies in Secondary Schools.
The History and Development of Technology.
Curriculum Development in Technological Education.
Microelectronic Technology in Society.
Problem Solving.
Analogue Electronics.
Constructional Electronics.
Electronic Communications.
Digital Interfacing and Computer Control.
Analogue Interfacing and Laboratory Instrumentation.
cAssembly Language Programming and Dedicated Microprocessors.
Project.

Thus to obtain the Degree in Technological Education, students should have obtained the Certificate and credits in 12 of the Diploma / Degree level units. In addition candidates must achieve a satisfactory standard in a written examination on the theoretical aspects of the electronics units. Since flexibility of delivery is the cornerstone of this retraining initiative, individual units may be taught in different locations by different tutors. It is then necessary to ensure effective administrative control over the teaching function and assessment procedures. For this purpose the National Course Management Committee was considered essential, assuming responsibility for organising the constitution of programmes, recommending members of the local course committees and local tutors to the University Board of Studies, and the validation / moderation of assessment procedures.

Units within the course are essentially modular in structure in order to achieve the flexibility required for offer in a variety of modes. Each programme is based in an approved educational centre and the exact nature of the provision negotiated with the each Educational Authority requesting the programme. The favoured options include:

i) a part-time 3 year course at an approved FE centre, with selected programme units taught by a member of University staff either on site or by arrangement at the University of Stirling.

OR

ii) a full-time 1 year course operated jointly between the University of Stirling and Falkirk College of Technology.

EVALUATION

Specific models of the prescribed programmes have been successfully negotiated with a number of Scottish local authorities in response to the urgency of implementing Technological Studies in schools. In each case technical teachers were selected by their education authority to make up a pilot cohort, and placed on the Certificate programme by part time study.

Recognising the potential spread of ability and "pre-knowledge" in what some regarded as unfamiliar or even alien territory a sympathetically structured approach was adopted by the tutors in the ensuing components of the first Certificate unit. The order in which units were presented to the technical teachers was determined by local centre staff and specifically based on the experienced judgement of the local course director. In all instances constant reference was made to the hardware and software systems likely to be encountered in the actual delivery of Technological Studies in the school.

The design and implementation of assessment procedures are the responsibility of the local centre with the ultimate approval and validation undertaken by the National Course Management Committee. Essentially, all assessment techniques highlighted the developmental profile of the students' understanding of the problem solving process, assimilation of technological facts and concepts and competence in effective reporting skills.

The effectiveness of this approach has been shown during the first year of operation by the high level of motivation of the students and by their rapid personal development. Despite the overall complimentary evaluation of the Certificate programme by all personnel concerned certain issues have come to light which must be addressed: -

i) the "mature student syndrome" - whereby personal expectation and dedication may be pronounced

ii) incompatability between apparently like software and hardware systems

iii) isolating the very real pressures of the school environment from the separate theme of a new technology retraining programme - this is a particularly prominent issue for Heads of Department

iv) ensuring that the student population appreciates the hierarchical nature of the retraining programme with reference to the tuition of Standard Grade Technological Studies.

CONCLUSIONS

In line with the aim of the retraining provision to develop project skills, the methodology successfully encompasses "learning by doing".

In a more exacting vein it is perhaps regrettable that Scottish Education has aligned itself to the BBC microcomputer, a non-standard machine, while the rest of the world has gone PC - compatible. It would therefore appear that a more profitable experience may result from the application of PC - compatible hardware, including plug-in peripherals and MS-DOS software, thereby maintaining this educational initiative in the real world.

THE COMPUTER AND TOM PAINE: US/UK TECHNOLOGY LITERACY AND DEMOCRACY

J TAYLOR

ABSTRACT

The proposed presentation represents the culmination of a decade's research into the evolution of Computer Literacy in the US and UK, from populist grassroots education, such as the People's Computer Company and the Community Memory Project in California, through to present day short-term training schemes and efforts to spread computing across the curriculum and market place both in the UK and in the US. It seeks to demonstrate that the course of this evolution represents, in democratic terms, a rise and fall, with a movement away from educating an informed citizenry, and towards fulfilling the short-term needs of the market place.

This argued decline in part mirrors the drive for a selective and limited literacy during the Industrial Revolution, again for market-place rather than democratic or cultural reasons.

It is proposed that the time is right for re-examining the original tenets of Computer Literacy in order to inform a more democratic future development. The damaging consequences of a purely market-driven Computer Literacy are reviewed, as well as the democratically empowering implications of a more informed Computer Literacy.

It is further suggested that education and training needs are not necessarily mutually exclusive, and highlights research to indicate that a democratic educational foundation is as essential to the more transient IT training goals of commerce and industry as it is for the long-term needs of a democratic society.

This paper draws from data largely the result of first-hand research into a variety Computer Literacy modes and initiatives in the US and UK, both in and out of formal education and training: eg, not just schools, colleges and universities, but also the media, museums, storefronts, prisons, etc.

This PhD research has been based at the University of London Institute of Education (Department of Statistics, Mathematics and Computing), aspects of which have been published in the US, UK and Australia in the following:

The Journal of Community Communications
Personal Computer World
Educational Computing
New South Wales Computer Education

The presenter is a Lecturer in Computing at Barnet College, London, an Advisor to Classroom Computer Learning (California), and an Education Advisor to Apple UK.

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THE EFFECTIVENESS OF DIFFERENT GENDER GROUPS FOR A CO-OPERATIVE COMPUTER-BASED LANGUAGE ACTIVITY

Geoffrey Underwood[1] and Jean Underwood[2]

ABSTRACT

The present experiment observed the performance of three types of gender pairings - boys with boys, girls with girls, and boys with girls - during the performance of a computer-based language task. Upper primary schoolchildren completed a short piece of text from which certain letters had been deleted. The task required the co-operative use of the computer keyboard, and the experiment asked whether there would be gender differences in performance, in comparison with the same children working individually. Four measures gave consistent results: both types of single-gender pairs improved in comparison with when working alone, but mixed-gender pairs did not. There were no other gender differences in performance. Informal observations suggested that single-gender pairs tended to share the components of the task and to discuss possible solutions, whereas the mixed-gender pairs tended to separate the task components and to work on each other's instructions.

INTRODUCTION

The questions asked in our study were whether individual work is preferable to group work in computer-based classroom tasks, and what gender compositions of groups are associated with optimal performance. The majority of primary school teachers tend to use microcomputers for group work: 42% of teachers only use groups, in comparison with less than 1% who use exclusively individual work (ref. 2). The remaining teachers use both methods. When organising the groups one of the popular criteria was gender, with 81% of teachers preferring mixed gender groups. Some of the teachers mentioned the benefits of group interaction during computer based activities, and most of them encouraged their pupils to talk, to reach group decisions, and to take turns at the keyboard. This role of language in groups as an aid to individual understanding is confirmed in the transcript of a group discussion between three primary school children engaged in a microcomputer data-base building task which we have reported elsewhere (ref. 6). In that example the importance of economic questioning can be seen to be appreciated through the discussion of alternatives, and can be seen to provide benefits for cognitive development through the acquisition of categorisation skills (ref. 7).

Teachers prefer to organise mixed gender groups rather than single gender groups, but in mixed gender pairs boys were socially dominant and girls both less motivated and less successful in a LOGO programming exercise (ref. 4). Given the stereotyped view of girls as disinterested, non-participating "computer-phobics" (ref. 3), it is perhaps not surprising that collaborating boys tend to take over the keyboard. The gender differences observed, it is important to note, are not associated with ability, for other studies have found no gender differences on computer-based learning and programming tasks (refs. 1, 8). The significant feature of these studies is that they used either segregated gender groups or individual testing.

In the following experiment we observed the influence of gender groupings in a computer-based language activity. The exercise involved a variant of the Cloze task, in which a piece of text was incomplete and which required the keyboard operators to find the missing letters. The program selected (Infant TRAY) is particularly useful in developing reading skills (ref. 5). The task required a combined use of orthographic, syntactic, and semantic knowledge in the completion of words, and of particular interest was the performance of children working in pairs, in comparison with their performance as individuals.

METHOD

Twenty-eight children from two classes of a Derbyshire school took part in this study. They were aged between 10:5 years and 11:4 years and there were equal numbers of boys and girls. All children worked individually in the first session and in the third session, and some worked in pairs in the second session.

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When working in pairs, the children worked with another member of the same sex, or with a member of the opposite sex: hence there were three types of paired groups. There were six children assigned to each of these three types of groups. Each child was randomly assigned to a mixed gender or single gender pair. The remaining five boys and five girls were tested individually throughout the three sessions.

The children worked with the M.E.P. program Infant TRAY, using a BBC B microcomputer. The program allowed the display of an incomplete passage of text, with certain letters missing from words. The task for the children was to fill as many of the letters as possible in a ten minute session. The time available was restricted to ten minutes per session because the experiment was interested in the effects of grouping upon immediate performance, rather than effects of extended practice. Children were not told about all of the facilities of the program, and in the experiment letters could only be entered by moving the cursor, entering a candidate letter, and pressing the return key (i.e., we did not allow the "buying" of letters).

Three different passages were used for the three sessions, and the passages were rotated across sessions such that each passage was used in each of the sessions equally often. The passages were chosen from intended for children aged 7 to 9 years and was well within the capabilities of the children. The three passages contained no dialogue, and contained similar numbers of words. They were not dependent upon the whole story, and could be understood in isolation. The versions of the passages used in the experiment had the first three words available, the first letter of every words available, and the three most common letters of each passage available. The three passages had 67, 78 or 79 letters missing out of totals of 155, 169 and 167 letters respectively.

In the first session, each child was individually told that the purpose was to complete as much of the passage as possible and given instructions on keyboard operation. They were told that they could attempt to complete letters in any order they wished, and as many times as they wished. In the second session, in which 18 of children participated in pairs, the pairs were told that the task was the same as that previously completed, but with a different passage, and that they were to work with their partner. The experimenter did not specify how the relationship between partners should operate. The 10 non-paired children continued as previously during the second session. The third session had all children again working individually. The experiment was completed within a two week period for each participant.

Table 1. Performance measures in the Infant TRAY version of the Cloze task for the three paired groupings. These children worked individually in Sessions 1 and 3, and in pairs in Session 2.

		Session 1 (individuals)	Session 2 (groups)	Session 3 (individuals)
Boys	letters attempted	17.2	37.3	27.0
	letters correct	14.7	33.3	22.3
	words attempted	10.5	19.7	15.5
	words correct	7.83	16.0	11.5
Girls	letters attempted	28.5	51.3	37.8
	letters correct	24.2	45.3	30.8
	words attempted	14.2	26.7	20.0
	words correct	11.3	20.3	14.5
Mixed	letters attempted	31.2	31.3	35.3
	letters correct	29.7	27.0	31.5
	words attempted	17.2	15.0	17.8
	words correct	16.3	11.7	16.0

RESULTS

The ten minute period of working started with the first movement of the cursor, and during this period each attempted letter was noted by the experimenter. The measures which were recorded were therefore the number of letters attempted, the number of letters correctly inserted, the number of words attempted, and the number of words correctly completed. The means for these four measures, for the three groups of subjects and over the three sessions of the experiment, are presented in Table 1. For data from the second session, in which the children worked in pairs, the measure for each individual was taken as the measure for the pair. The four measures were submitted to four analyses of variance to identify effects of paired groupings over the three sessions.

For the total number of letters attempted, the anova indicated a main effect of sessions ($F=10.28$, $df=2,30$, $p<0.001$), no main effect of gender groups ($F=1.62$, $df=2,15$), and an interaction between these two main effects ($F=2.90$, $df=4,30$, $p<0.05$). The main effect of sessions was for the paired groups to produce more attempts than during individual testing, but this interacted with gender and so an analysis of simple main effects was performed. This indicated an effect of sessions for paired boys ($p<0.01$) and for paired girls ($p<0.001$), but no change in the number of attempts for the mixed pairs. Pairwise comparisons were performed within each of three paired groups, to determine the changes in performance between sessions. For both paired boys and paired girls, paired performance was more productive than individual working in the first session (both $p<0.05$), but individual performance in the third session was not reliably improved over that in the first session. For the mixed pairs there were no differences between any of the sessions.

A similar analysis was performed with the number of letters correctly inserted as the measure. There was again a main effect of sessions ($F=6.69$, $df=2,30$, $p<0.005$), no main effect of gender ($F<1$), and an interaction between these factors ($F=2.73$, $df=4,30$, $p<0.05$). The interaction was again inspected with an analysis of simple main effects. There were effects of sessions, with improvements due to paired groups over individual working, for paired boys ($p<0.02$) and for paired girls ($p<0.005$), but not for mixed pairs. Pairwise comparisons indicated that both boys and girls increased their performance in pairs in comparison with the first session (both $p<0.05$), and that the performance of mixed pairs did not vary over sessions. Performance in the third session was similar to that in the first session for all three groupings.

The number of words attempted were also submitted to an analysis of variance. This also showed a main effect of sessions ($F=6.58$, $df=2,30$, $p<0.005$), no main effect of gender ($F=1.17$, $df=2,15,$), and an interaction between these two factors ($F=3.12$, $df=2,30$, $F<0.05$). The analysis of simple main effects indicated an increase in the number of words attempted for paired boys ($p<0.05$) and paired girls ($p<0.005$) but no change in the number of attempts by mixed pairs over the attempts made by individuals. Pairwise comparison indicated improved performance in session two for both paired boys and paired girls (both $p<0.05$), but no differences between sessions one and three. The mixed pairs produced consistent performances over all three sessions.

When the number of correctly completed words was considered, the pattern of results was changed a little. There was a marginal main effect of sessions ($F=2.82$, $df=2,30$, $p=0.07$), no main effect of gender ($F<1$), and an interaction between these two factors ($F=3.39$, $df=4,30$, $p<0.05$). The analysis of simple main effects used to inspect the interaction revealed effects of sessions for paired boys ($p<0.05$) and for paired girls ($p<0.05$) and no change in the performance of the mixed pairs. The pairwise comparisons indicated improvements relative to the first session for paired boys and paired girls (both $p<0.05$), but no improvements between sessions one and three when they were working individually. The mixed pairs performed consistently during all three sessions.

Table 2. Performance measures in the Cloze task for the non-paired children. These children worked individually throughout the experiment.

		Session 1	Session 2	Session 3
Boys	letters attempted	24.4	33.8	31.6
	letters correct	18.8	27.2	23.8
	words attempted	16.0	19.2	21.4
	words correct	10.6	14.4	14.8
Girls	letters attempted	23.4	33.2	27.4
	letters correct	18.6	28.2	23.4
	words attempted	15.0	20.0	17.8
	words correct	11.2	16.2	14.0

For the children who worked as individuals throughout the experiment (see Table 2), all four measures showed the same same pattern of performance. The were no differences between boys and girls, and no interactions. Performance improved from session one to session two, but there were no differences between sessions two and three. This was the pattern observed when number of letters attempted, number of letters correct, number of words attempted, and number of words correct, were in turn observed.

DISCUSSION

The four analyses of performance measures provide a consistent pattern over the course of the experiment, although the small number of children tested means that we should be cautious in the interpretation of the results. When single gender pairs work together there is an increase in the level of activity in response to the task of completing the story, and this is associated with an increase in the number of correct completions. This is the pattern when both letters and words are used as the unit of measurement. When mixed gender pairs work together, however, there is no noticeable increase in the number of attempts or number of correct completions. Indeed, the data presented in Table 1 indicates that if anything the level of activity decreases. In moving from individual to paired working arrangements, single-gender groups of boys and girls improve in their number of attempts and in their number of correct attempts, but mixed groups do not. The mixed groups worked effectively, but did not improve on their performance as individuals.

There were no overall gender differences in any of the measures taken, and this is consistent with previous work looking at performance measures on computer-based activities. Neither were there any improvements over the course of the experiment for children working individually. In the third session, after having worked in pairs, performance returned to the level initially observed in session one. The differences between gender-based groups which are apparent in session two are not, therefore, a result of the practice gained in the first session. If practice had been responsible for the improved performances in session two, then gains should have been apparent in session three, and all three groups should have improved in session two. Single-gender pairs show an improvement relative to the performance of the same children when working individually, but mixed pairs show no improvement. Previous research which has investigated gender differences in performance with computer-based activities has generated few reports of differences. These studies of gender differences suggest that girls work as effectively as boys (refs. 1, 8), but in these studies the boys and the girls worked either individually or in segregated groups. Mixed gender pairs work at a disadvantage relative to the single-gender pairings.

We did not attempt to have the children in this study work co-operatively in any particular way, but we did make informal observations of the task-sharing organisations which emerged. In general the single-gender pairings worked by discussion and agreement, with each member of the pair contributing to the decision about which letters were likely and which should be attempted. Children working in mixed pairs tended not to work by negotiation to achieve joint problem-solving, but co-operated by instruction. One child would take over the keyboard cursor controls and return key, and their partner would say where to move the cursor and when to enter the choice by pressing the return key. There was very little discussion of alternative letter solutions in the mixed-gender groups in the present experiment, and other workers have also commented upon the lack of co-operation between boys and girls in paired activities (ref. 4). If teachers are to continue to prefer mixed gender organisations for group work, then the quality of cross-gender discussion and negotiation will need to fostered if the group facilitation effect is to be gained for mixed-gender co-operative groups in the computer-based classroom.

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LOGO AT THE COGNITIVE STUDIES LABORATORY IN BRAZIL

Lea da Cruz Fagundes*.

At LEC (Laboratorio de Estudos Cognitivos) in Porto Alegre, capital of the southernmost state of Brazil, we develop basic and educational research. Our aim is to build up knowledge in order to change educational practice, along with the development of a new culture with the computer revolution.

Based on the Piagetian theory we look for new ways of interpreting the learning process of children, adolescents, adults and the elderly. We use the LOGO programming activities in order to construct explicative patterns concerning the information processing and knowledge representation.

We follow two basic lines. The first one develops studies on literacy, language arts, mathematics, physics, art-education and music. The second one tries to build up interventional patterns in order to bring out changes in the learning environment of public school students. Our purpose is to study the influences this new learning environment has on the learning processes.

We also study the best way to prepare human resources in order to improve these processes and the changes they bring along.

The projects we are developing are:

Literacy: we started this project in 1984 with 3 Ss, and now we have reached 160 Ss. These experimental different groups are formed by children who have no preschooling, or by first grade students who come either from kindergarten or from special classes. We also have students who are repeating the first grade, some for the third year. The results show that programming improves the conceptualization levels of the written word as well as the writing ability, according to Emilia Ferreiro's work. Language Arts: our aims are to investigate the possibility of using LOGO as an aid for children's thinking and learning in Natural Language; to comprehend now children understand and process linguistic information through the analysis of the way they build linguistic rules in LOGO programmimg; to verify the effects of computer based environments over the child's linguistic competence. 24 children are programming with words and lists. Thereby a programming handbook

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is available.

Mathematics: we study children's spontaneous concepts of number, number relations, positional systems, non - Euclidean and Euclidean spaces, measurement, problem solving, and so on. All these ideas are developed and expanded within experimental activities in programming. Our studies intend to construct patterns of logical structures of the child's reasoning , according to Piagetian concrete logic.

Physics: We are studying the cognitive mechanisms present in physicogenesis of elementary physical notions during the activities at the experimental physics laboratory alongside with the exploration of LOGO microworlds.

Art-Education and Music: Can the computer help to develop the capacity to choose and the critical ability that can be translated into the aesthetic consciousness? Can the LOGO learning environment help the children to select their own scale of values without having them imposed and be able to select and recreate these values? In order to answer these questions we are developing a research with 10 Ss (10/12 years old) who are students at a public art center.

Handicapped children: different learning disabilities, cerebral palsied children, neurotic and psychotic children are being attended at LOGO environments in order to attain a better diagnosis of their cognitive and affective structures.

Applied research: students of the Organizational Psychology courses help to develop the researches at schools. At these schools there are teachers who have been trained at LEC and work with children in LOGO environments. Different training courses have been developed at LEC trying to reach the best educational alternative. Either these teachers at schools as well as researchers at LEC develop new tools and microworlds to enrich the LOGO environment.

As far as now the numbers we reached are: 6 public schools, 180 trained teachers, 71 teachers in computer based environments, 40 graduate students, 10 researchers and 3000 students (from 7 to 14 years, adults and ancients).

GENDER AND SOCIAL INTERACTION IN EARLY LOGO USE

Martin Hughes and Pam Greenhough*

ABSTRACT

Thirty pairs of children aged 6/7 years were divided into three matched groups - one group of 10 boy-boy pairs, one group of 10 boy-girl pairs, and one group of 10 girl-girl pairs. The children were studied over three sessions in which they learnt to take the Logo floor Turtle around a specially constructed track. The performance of girls in girl-girl pairs was significantly worse than that of girls in boy-girl pairs, with the latter performing at the same level as boys. The performance of the boys was unaffected by the gender of their partner. Subsequent analyses indicate an attitudinal rather than a cognitive explanation for the main findings. The study has implications for several areas of research, including the learning of Logo, social interaction at the computer keyboard, and gender issues such as single-sex versus mixed-sex grouping in the classroom.

INTRODUCTION

The research described in this paper brings together three issues of concern for educationalists interested in the implementation of computers and technology in the classroom. The first issue concerns the educational programming language Logo. While many people have followed the lead of Papert (ref 1) in advocating the use of Logo throughout the educational system, recent reviews of subsequent Logo research (eg. Johanson, ref 2) suggest that the most optimistic claims for Logo cannot be justified. Nevertheless there remains a clear need for detailed and systematic studies of exactly what children are learning when they are introduced to Logo, and how this learning takes place. The second issue is that of gender: there is growing concern amongst educationalists and others that girls will be placed at a serious disadvantage compared with boys as computers and other forms of technology are increasingly used in the classroom, and evidence is starting to emerge which shows that this disadvantage manifests itself even in very young children. For example, in a previous study we found that 6-year-old boys made significant gains on a standard abilities test after 6 months learning with the Logo Turtle, but that 6-year-old girls did not make such gains (Hughes, Macleod and Potts, ref 3); we also found in a separate study that many 7-year-old children have already internalised the belief that "computers are for boys, not girls" (Hughes, Brackenridge and Macleod, ref 4). The third issue we want to address is the relationship between social organisation at the keyboard and children's learning. It is likely that scarce resources for the foreseeable future will mean that expensive

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items of technology like computers will not be available to children on an individual basis; instead children will encounter them in small groups. Indeed, it has sometimes been argued that computers lead to social and interpersonal gains as much as they produce more cognitive gains. Clearly there are strong connections between this issue and that of gender; it is often argued that girls are inhibited by the presence of boys in social groups interacting around computers, and indeed many have argued for single-sex grouping in such classes. The amount of systematic research on this question is however extremely small.

In order to investigate the above issues we carried out a study in which 60 children aged 6 to 7 years were introduced in a systematic fashion to the Logo Turtle. The specific question we wanted to answer was this: does the gender composition of pairs of children affect their performance with the Turtle?

METHODS AND DATA COLLECTION

The 60 children were divided into three matched groups of pairs so that 10 pairs were boys-only, 10 pairs were girls-only, and 10 were mixed. The children spent three sessions of around 15 minutes working with the Turtle. During the first session each pair familiarised itself with the Turtle in a totally unstructured situation: they were shown how to make the Turtle move forwards, backwards, left and right, and then allowed to move it as they wished over a large board. In the second session each pair was asked to carry out a specific task with the Turtle, namely steering it around a specially prepared track as quickly and as carefully as they could. In the third session the children were seen individually and asked to carry out the same task as in the second session. There was an interval of about a week between each session. Apart from introducing the session, the adult intervened as little as possible in what the children were doing. All sessions were video-taped, and each keypress on the computer was automatically recorded using a dribble file.

FINDINGS

The findings were both clear-cut and unexpected. The performance of the boys on the task was unaffected by whether they worked with another boy or with a girl. However, the performance of the girls was clearly affected by the gender of their partner. Girls who worked with boys in mixed groups performed at the same level as the boys; however, girls who worked with other girls in girl-girl pairs performed at a significantly lower level. These differences were quite large. For example, only two of the ten girl-girl pairs completed the task within the 15 minute period, compared with nine out of ten boy-girl pairs and all ten boy-boy pairs. Exactly the same pattern of differences emerged in the children's individual performance on the track task in the final session.

Two further analyses have been carried out on the data. The first looked at which aspects of Logo performance most differentiated the groups. This analysis made use of a simple model of ideal task performance, and the children's actual performance was then compared against the ideal. This analysis showed that the main differences between the groups were associated with the Turtle colliding with the side of the track - "crashing". The girl-girl pairs were more likely to crash the Turtle than the other pairs; in particular, once they had crashed the Turtle, they were more likely to adopt an inappropriate strategy for freeing the Turtle. There were no differences between the groups on such measures as the number of left/right mistakes which they made, or their ability to estimate angle or distance.

The next analysis therefore looked more closely at the social interaction which took place just before and just after crashes. One hypothesis we wanted to investigate was that, in the boy-girl pairs, the boys might be teaching the girls, or demonstrating superior strategies to them. There was little support for this hypothesis, as the girls seem to be teaching the boys as much as the boys taught the girls. A more likely explanation focuses on the girls' reaction to crashes in the girl-girl pairs. These pairs seem to react in a more emotional fashion, and there appears to be a higher level of blaming and criticism in these pairs. This would suggest that an attitudinal rather than a cognitive factor is involved: the girl-girl pairs appear to react in a particularly non-productive way to what they perceive as "failure" on the task.

CONCLUSIONS AND IMPLICATIONS

The findings reported here are unexpected and provocative. However, they arise from a single study, and clearly need replicating. In particular, we need to know how far they are a function of factors such as the children's age, the software being used, the amount of time the children spend working together, and the size of the group. If they are found to be replicable, even if only in particular circumstances, then they have immediate relevance for the use of computers and technology in the classroom. In the U.K. at least, there is a growing body of opinion which claims that the disadvantage of girls can only be overcome if they are separated from boys and required to work in girls-only groups. Yet our current findings suggest that this may be the least optimal condition for girls to be using computers.

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COMPUTER SIMULATIONS: EDUCATIONAL OPPORTUNITIES AND RESEARCH NEEDS

Jerry W. Willis 1 and Dee Anna Willis2

ABSTRACT

There are several reasons why instructional simulations are seldom used in education today at any level. A major reason is education's focus on simple declarative information, which can be taught by drill and practice and tutorial software. That must change if we are to accomplish what modern society asks of education. Higher level cognitive skills can be effectively and efficiently taught by computer simulations, and new authoring systems make it easier to develop instructional simulations.

If simulations are to gain wider acceptance in education, however, the field desperately needs additional research. The research need is not the traditional Good Way versus Bad Way comparison. We need formative and summative evaluations of simulations, aptitude-treatment interaction research, component analyses, and critical evaluations of the components of simulation packages to identify active, inert, and negative ingredients of the package.

Microcomputers are now available, at least in small quantities, in most elementary and secondary schools as well as in colleges and universities. Unfortunately, the current patterns of use for this advanced technology are not always based on our best theories of learning, on the most relevant models of the curriculum, or on current models of instructional design.

The technology is most often used to teach basic declarative or factual information through drill and practice (D&P) or tutorial programs. A high percentage of the commercial instructional software available today, and most of the software developed by educators for local use, is based on either a simple D&P model or a linear tutorial model that is similar to programmed instruction (Merrill, 1987). This is true even of instructional packages that use advanced CD-ROM and videodisc technology.

There are numerous reasons for this pattern. First, at all levels of education, from kindergarten to graduate school, it is easier and more convenient to teach declarative information than procedural information, intellectual skills, or problem solving. Second, at all levels of education, from kindergarten to graduate school, teachers have had more training and more experience teaching declarative information than any other type. It is therefore not surprising that the focus at all levels is on teaching this type of information.

In this context, it is not difficult to see why a great deal of D&P and tutorial software is available and is widely used. It is relatively easy to develop (in comparison to simulations), and it fits the teaching pattern of many educators. Incorporating D&P or tutorial software into the curriculum is relatively easy for most educators. Few adjustments would be needed, for example, to begin using tutorial software to teach declarative information in a psychology class that has traditionally been taught by the lecture method. Many more adjustments would be needed to begin using simulations to teach scientific procedures or clinical problem solving skills. The tutorials are simply an extension of an established pattern. The simulations would require a rethinking of the objectives, the way the teacher interacts with the students, the way students interact with each other, and the method of evaluating students and assigning grades. (Note: In this paper the term simulation refers to software such as physical science simulations and business games. In specialized journals the term simulation/games often refers to the same type of instructional software discussed here.)

Creating simulations is also generally more difficult than the creation of D&P or tutorial software. "The scarcity of good simulations is probably due to the fact that developers must be expert in programming, in the experience to be simulated, and in child psychology and learning principles. Such people are scarce" (Maddux and Cummings, 1986). The decision to use simulations in the classroom is also more complex and

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more difficult. It is not surprising, therefore, that simulations are relatively rare in classrooms at all levels. It is also unfortunate because computer simulations have a great deal to offer.

Type I and Type II Educational Computing

In an article titled *Educational Computing at the Crossroads*, Maddux and Cummings (1986) argue that educational computing "is at risk of failure, due to the manner in which it is being used." They divide educational computing uses into two types. "Type I uses make it easier, faster, or more convenient to continue teaching as we have always taught. Type II uses make available new and better ways of teaching and learning." The great majority of uses today are Type I (such as D&P, tutorial, computer managed instruction, administrative support, and assessment), and Type I computing simply helps educators be more effective at what they are already doing. A growing number of commissions, reports, and studies repeatedly make the point, however, that the needs of a modern, information-intensive society demand that educators do something different. Maddux and Cummings (1986) believe Type II uses such as simulations are different because they tend to be learner centered; they encourage significant student involvement, and they focus on facilitating higher level cognitive skills that are ignored in many classrooms.

Maddux and Cummings are concerned that educational computing may become a passing fad, like many other instructional technologies of the past, if it continues to concentrate on Type I methods. Their point is well taken. The increased development and use of Type II applications such as simulations would benefit the cause of educational computing. It would also benefit education.

USING SIMULATIONS IN THE CLASSROOM

Using a simulation in the classroom involves more than simply plugging in the computer and providing the software (Willis, Hovey, and Hovey, 1987). Horn and Cleaves (1980) divided the use of instructional simulations into three phases: Preparation, Supervision, and Debriefing. To that we would add three additional phases: Selection, Adaptation, and Evaluation.

Selection. The process begins with the selection of the simulation. Where no suitable simulation is available this phase may involve the development of a simulation for local use.

Adaptation. Although many good simulations are available today, virtually any simulation you select will require some adaptation to fit local needs and conditions. Issues such as the time available and the resources required may require numerous adaptations.

Preparation. Educational simulations must be integrated into the overall instructional plan if they are to be maximally effective. As with any teaching method you must determine the scope and sequence of the experience, select appropriate supporting materials, and plan any preliminary activities that will be needed to prepare students to run the simulation.

Supervision. When students play the simulation, the role of the teacher is dependent on the objectives of the simulation, the type of simulation used, the maturity of the students, and the educational setting. Very few simulations are stand-alone educational experiences that require no supervision or teacher involvement. The teacher's role can range from that of a war games style referee to helper and guide or hardware and software troubleshooter.

There is also an important *window of opportunity* for learning while students are running the simulation. Discussions of issues related to the simulation are likely to be more lively, students may be more interested and more resourceful about getting information needed to master the simulation, and the teams that play the simulation often develop a cohesiveness and energy that is both surprising and pleasing. With careful encouragement and leadership, the simulation can become the hub for a wide range of learning activities.

Debriefing. An important, though often overlooked, aspect of any instructional procedure is the post-activity debriefing or review (Pearson and Smith, 1986). Debriefing is especially important with simulations because the major instructional objectives are often accomplished through activities that do not appear to focus on those objectives. During the debriefing phase a discussion of the issues students dealt with in the simulation often helps them consolidate the concepts and procedures they learned in the simulation. Debriefing also helps students identify misconceptions or inaccurate assumptions about the simulation, and provides an opportunity for students to discuss the differences between the simulation and reality.

Evaluation. Several aspects of research and development are discussed later in this paper. At a minimum, however, the simulation should be evaluated systematically. Did it accomplish the desired cognitive and affective objectives? When it is used again, would it be more effective if some adjustments or changes were made? In many cases the students can provide excellent suggestions for improving the way the simulation is used.

DEVELOPING EDUCATIONAL SIMULATIONS

Developing educational simulations is a complex process, and several authors have developed useful theoretical and procedural frameworks to guide the process (Merrill, 1987). We have found Cruickshank's

(1986) model of teaching alternatives to be useful when considering whether or not a simulation should be developed to teach a particular skill. He argues that there are three types of instructional alternatives. There is Concrete or "direct first-hand experience" such as internships, practicums, microteaching, simulators, and simulation games. A second instructional alternative is Vicarious "indirect, second-hand experience" such as observation, protocols, and films. The third instructional alternative is "Abstract, third-hand experience." This third category includes a wide range of alternatives including lectures, case studies, discussions, D&P and tutorial CAI, and recitations.

Cruickshank based his three-category scheme on the work of Bruner (1966) and Dale (1969). Dale's categories of "direct," "iconic," and"symbolic" describe essentially the same three instructional alternatives as Cruickshank. He takes a step beyond Dale, however, by presenting another continuum along which instructional alternatives can be placed. The second continuum is the context of experience. Cruickshank points out that all instructional alternatives are either Real or Modeled. The physician's internship and the engineer's co-operative experience are Real. When the physician-in-training plays a simulation to diagnose a *simulated patient* and the student engineer runs a simulation to design a *simulated bridge*, the instructional experience is Modeled.

Many recent reports have been critical of education's over-reliance on Abstract-Model instructional methods such as the lecture. Many professional skills and many higher level cognitive skills are probably best learned through experiences that are Concrete-Real or Concrete-Model. Under ideal circumstances, students who spend a great deal of time in Concrete-Real learning contexts should master professional and problem solving skills best, and some professions, such as medicine, do provide extensive Concrete-Real experiences. Concrete-Real instruction is, unfortunately, very expensive. Under current conditions, students in most disciplines receive a minimal amount, if any, of Concrete-Real instruction.

In the many situations where it is desirable but not possible to provide Concrete-Real instruction, computer simulations are an ideal way of providing Concrete-Model instruction. When compared to Concrete-Real alternatives such as the physician's internship or residency, computer simulations offer educators an economical, even cheap, method of providing students with Concrete instruction.

Where no suitable simulations exist, many educators should consider developing their own. However, developing a simulation involves a tremendous investment of time and effort. It is not the type of project to be entered into lightly, particularly if you have limited programming experience. Fortunately, the effort involved can be significantly reduced if one of the new authoring languages or systems is used. We particularly recommend *Course of Action* and *Course Builder*. Both are sophisticated authoring systems that allow developers to concentrate on the simulation instead of the programming process. Courseware that would require more than a thousand hours to develop using with a standard programming language such as C or Pascal can be developed in 50 to 150 hours with authoring systems such as Course of Action or Course Builder.

For those with programming experience, authoring systems such as Extend, which is designed specifically to create simulations, can provide a similar time savings.

RESEARCH NEEDS

Much of the relatively sparse research literature on simulations uses a traditional *The Good Way versus The Bad Way* model. A simulation is compared to some other method of teaching the same material.

Although this type of research has a place, it does not answer any general question about the value of simulations compared to some other teaching method. There are good and bad simulations, simulations that teach one type or level of objective better than others, and simulations that must be used in a particular format or in conjunction with other instructional methods to be effective. The same can be said for other types of instruction. Because there is no one monolithic, unitary entity called Simulation (or lecture, or D&P, or tutorial CAI), it is not possible to draw general conclusions from Good Way versus Bad Way studies. The time and effort invested in such research would be better spent on other questions.

Initial Formative Research. The first research on any simulation should be an integral part of the development process. The goal of that process is to develop the most effective simulation possible, and formative research is a crucial element of that process. Formative research should involve both expert appraisal and tryouts with students similar to those who will use the simulation. Although the primary use of data from the formative evaluation is as feedback to guide simulation refinements, a number of research reports in the literature rely on this type of data.

Summative Research. Once the simulation emerges from the formative evaluation stage, it should be carefully evaluated again. If the simulation will be used as a replacement for another instructional method, it should be compared to that method. Is it more effective in accomplishing instructional objectives? Is is more economical? That is, does the simulation make efficient use of available resources such as teacher time and effort? At East Carolina University, for example, we have conducted an evaluation on a simulation called

IRIS that trains teacher education students to administer an informal reading inventory. It was compared to the instructional method in use when the simulation was developed.

If the simulation will be used to teach new objectives, the degree to which it accomplishes those objectives should be determined. The goal of a summative evaluation is not to demonstrate that simulations in general are Good and Grand, however. The goal is to demonstrate that the simulation you have developed or are using accomplishes important instructional objectives. General support for educational simulations can only emerge from the accumulation of solid research data on many different simulations in many different settings. Solid research data is sadly lacking in the simulation literature today. In a recent review titled *Where are We? An Analysis of the Methods and Focus of the Research on Simulation and Gaming*, Butler, Markulis, and Strang (1988) examined articles published in two major research outlets, the journal *Simulation & Games* and the annual *Proceedings of the Association for Business Simulations and Experimental Learning* (ABSEL). From 1974-1977, only 22% of the articles published in *Simulation & Games* and 2% of the ABSEL papers met the authors' minimum criteria for classification as an experimental study. The three criteria were: (1) use of a control group, (2) random assignment, and (3) a clearly defined treatment condition that was compared to another instructional alternative. From 1981-84 the percentage dropped to 7% for the journal and remained essentially stable for the ABSEL papers. We are moving in the wrong direction! The authors concluded that "those interested in simulation gaming as a vehicle for teaching and learning need to encourage researchers to employ stronger designs and thus develop the reliable knowledge base essential to effective utilization of experiential exercises."

Aptitude Treatment Interactions. Do students with certain psychological or learning characteristics profit more, or less, from simulations? Do different types of students learn more from different types of simulations? Does the mix of students who work on a simulation together make a difference? As more research on the effectiveness of different simulations accumulates, questions like the ones above that address the issue of aptitude-treatment interactions will become more important. Very little of this type of research has been conducted thus far on simulations.

Component Analysis and the Search for Active Ingredients. A sadly neglected aspect of research on most types of instructional software involves an analysis of components. The use of instructional software in the classroom is really the use of a package of instructional methods. We may think of the package as if it were an indivisible whole, but that is not really the case. Each of the phases in the use of a simulation can be accomplished in many different ways. There is little research on the different components of a simulation package, however, and little empirical data to guide us when we develop a simulation. Are there advantages, for example, to students completing a simulation in small groups or is it better for students to complete the simulation individually? Does the type of simulation or the type of instructional objective influence the group versus individual decision? Should students learn principles or concepts first and then apply them in the simulation, or is it more effective for students to run the simulation and let the principles and concepts emerge from their work? There is very little research to help us answer such questions and many more like them.

An analysis of the components that make up an instructional simulation may also indicate that some components are *active* or effective. They contribute to the overall positive impact of the package. Other elements may be inert. They neither help or harm. Still others may actually be detrimental. They may reduce the effectiveness of the simulation. Very little of this type of research has been conducted on educational simulations, but a great deal is needed. For example, many simulations involve competition. Is this necessary? Would cooperative simulations be more effective?

As with formative and summative research, no single study will provide The Answer to any of our questions. But as the evidence from individual studies accumulates, we can begin to develop general conclusions that can guide us as we create and use educational simulations.

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DIGITAL ELECTRIC TRAINS IN THE K-12 CLASSROOM

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ABSTRACT

Digital electric trains have come to the attention of educators and administrators at a critical time when schools are deeply concerned with at-risk students, finding creative uses for computers in the classroom, developing both cooperative learning and critical thinking skills, encouraging girls to participate in computer learning activities, and improving computer literacy among those students in the lower two-thirds of the higher learning skills (math and science particularly).

The following is a thought/process paper that evaluates the new technology of digital trains that are becoming popular in school districts across the country. These trains allow for multiple students to control electric trains on common tracks thereby promoting cooperation, communication, and interactive problem solving. Computers can also be connected to the trains through an interface that is built into the digital system. The addition of the computer makes it possible to teach computer skills with the trains as the output device. Trains not only become a real time control device, but they also have sensors that can communicate with the computer making it a two way interactive problem solver.

INTRODUCTION

In 1984, Marklin of West Germany introduced a "Digital" electric train that differed from traditional toy trains in that it was controlled by a digital computer chip placed inside each locomotive. These controller chips could be individually addressed and operated by more than one person from either electronic control units or computers. These enhancements also moved the operation of electric trains from what was virtually a single person experience to being a group activity. Eighty locomotives can be controlled by ten different "engineers" at the same time on the same common track. This is enhanced by the ability to control over 250 accessory devices such as track switches, signals, uncoupling devices and lights. The resulting demand this places on interactive cooperation in a "play" atmosphere is exciting.

TEACHING

Marklin was obviously aiming this new product at the growing model railroading hobby market, but soon after it was introduced, the educational value was seen both in Europe and in the United States. Now Marklin, GmbH in West Germany and Marklin, Inc. its subsidiary in the U.S.A. both support educational divisions that are developing curriculum support materials in "hardware" (trains), "software" (computer programming materials) and "teachware" (teacher's outlines for classroom use). Materials are being developed for all grade levels from kindergarten

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through twelfth grade, and college and trade schools are also using the trains in numerous subject areas. The appeal to education is the multifaceted use for the trains. The math teacher can create true to life visible story problems, the science/physics teacher can show in a very appealing model how electricity works, how electronic/computer components operate and can conduct experiments on acceleration, centrifugal force, power, and other science topics. Computer teachers have found in trains a new tool for teaching programming skills with computer output controlling trains as real time devices, which is more appealing than printing Christmas trees or Snoopy calendars on the printer. Bayer Chemical teaches its robotic engineering trainees to program trains running on tracks as a simulation of chemicals flowing through pipes with turnouts representing valves and junctions.

Subjects other than science, math and computers are also being addressed with the trains. Schools using the trains in Utah have found applications beginning as early as the kindergarten classroom. The younger grades of kindergarten through second grade have used the trains to teach about transportation and community building. Although the track is easy to put together, it has been found to be more convenient to have a "layout" already mounted on a portable piece of plywood ready to put on the floor or on a table. At this early grade level it's also recommended that teachers use different types of engines (i.e. diesel, steam, and electric). This allows for discussion on the various sources of power, how each type of engine power found uses in different time periods and in different geographical locations in the world. Using simple construction blocks, the student can build towns and other support facilities for the trains. Steam locomotives need coaling facilities, water towers and engine repair sheds, passenger trains require stations, and freight trains need warehouses. As train tracks are laid through the countryside, towns spring up and cities develop from those small towns. The train experience is a geography lesson, a history lesson, a sociological study and a technology experience all rolled into one.

A Utah elementary school in the Granite School District of Salt Lake County has constructed a large 8 x 16 foot layout depicting the proposed light rail system for Salt Lake Valley. School administrators have combined the digital trains with twenty Tandy computers in a computer/ train room for all students from kindergarten through sixth grade. The layout is not only a geography and computer project, but is regularly being used for art projects at all grade levels.

RESEARCH

Another interesting application for the digital trains is in the research setting. This year Brigham Young University began its second research study using the trains as a problem solving tool. Research subjects work out problems with the trains while observers gather data on the problem solving and decision making process that occurs. The trains are superior to other "tools" experimented with in the past because they're appealing to all ages, simple to operate (other activities such as simulation games often involved an excessive waste of time teaching rules), mandatory (participants are obligated to participate since their train occupies space where others need to move) and they're limiting (i.e. participants must interact in the same environment, they cannot take their project and move to a corner of the room and work alone). All these factors are essential in conducting problem solving research and prior to digital trains it was difficult to find activities where subjects could interact which also provided all these characteristics.

This opportunity to bring students together in an attractive, cooperative, fun, learning experience, led to one of the first applications in the schools. Elementary school counselors found the trains to be a rich source of cooperative activity among non-cooperative students. Trains have been used as achievement incentives, to help develop a sense of control and responsibility through the need to follow directions, to teach interpersonal cooperation, aggressive restraint, used for peer teaching through verbal demonstration and communication, and as guided problem solving tools.

The multi-educational approach with the digital trains have made them attractive to schools as teaching tools that can be placed in a media center or closet for checkout and use by any of the teachers or counselors. They have proven to be more than scientific apparatus for single subject use. The Marklin Digital trains also have the ability to connect to any computer with an R232 serial port. This is different from other technology tools such as the construction sets from Lego or Fisher Technic whose programs are limited to a couple of computer types and have restrictive programming capabilities. Digital trains are controlled by sending out command strings through the serial port. This allows for any programming language to control the trains. It doesn't matter whether a school is teaching BASIC, Pascal, Fortran, C, or Prolog, all languages provide for outgoing data. It's as simple as sending output to a printer. Each train is controlled by two bytes of data, one for the command (whether that be speed, direction or a special function such as lights, smoke or coupling) and the second byte is for the engine address. Each engine will respond only to its address and command, all others continue with their previously encoded commands.

One of the more recent concerns among computer educators centers around the diminishing numbers of girls participating in computer learning activities as they get older. Some high schools report that they have no girls in the memberships of their computer clubs, yet in the early grades (starting about fifth grade) girls seem to have as much fascination with computers as boys. But, as girls get older this interest wains. Some studies suggest that this may be due to the fact that pre-teen girls find boys their own age to be repulsive. These boys hang around the computers at school and girls that will either ignore them or put up with them in order to work on the computers are pretty rare. Preliminary studies in pilot schools in Utah have shown that girls are becoming more interested in computers connected to trains in spite of the presence of boys.

A long range study was begun in 1987 with girls in grades 5 through 12 to determine whether computer learning that has been interactive with trains, and thereby fun, more "play" oriented, and demonstrating some connection to the real world, will 1) show a higher level of interest and 2) remain more constant in their computer interest than girls that experienced computer learning without being interfaced to digital trains. This study will track two populations of girls (with and without the train experience) through secondary schooling and educational experiences after high school graduation to measure the differences in computer interest and vocational choice. The growing need for computer literate graduates to fill technology positions in industry and management demands that all students be given equal opportunity to share time on computers beginning with the earliest grades where interest is demonstrated.

This demand for "equal time" is also being researched with regard to "at-risk" students. For the purpose of this research, "at-risk" is defined as those students that test in the lower two-thirds of math and science skills. These students are also frequently "turned-off" to computers which they perceive as tools for the scientist or mathematician. The growing role of computers in industry where they mostly fulfill robotic functions necessitates a need for individuals that are not computer-phobic. Workers that are replaced on the assembly line by robots are not unemployed, but are rather retrained to fill more exciting and rewarding jobs than those filled by the robots. Much of this retraining regards the maintenance and programming of the robots that replaced the worker in the first place. To better prepare students for employment that requires computer or electronic experience, schools need to integrate computers, electronics, and technology into real world experiences. Digital trains can provide this integration, and here again long range research studies have begun to observe the "at-risk" students that interact with digital trains. Do these students develop more interest and better computer skills when computer learning is combined with real world technology such as the trains, than when computer learning is confined to the computer components themselves (i.e. printers, CRT monitors, and disk drives)? The long range research hopes to answer this question.

SUMMARY

Digital electric trains attract students. They are fun and provide a level of enjoyment that when coupled with computers enhance computer education unlike anything used before. Current preliminary studies from various research locations have reported a high level of interest among both girls and boys, and students of all levels of learning ability. Digital trains are becoming a new teaching tool to help us better understand our "Information Age" and "Space Age" present as well as our technology filled future.

THREE WAYS OF RELATING PROBLEM SOLVING TO THE USE OF INFORMATION TECHNOLOGY IN SCHOOLS

Maurice Hart *

ABSTRACT

School students are encouraged to articulate problem solving processes and then use them to structure and report on work with Information Technology in various curriculum areas. Three fairly distinct relationships between the use of these processes and I.T. have been identified. Specific benefits of using this procedure have appeared in each case.

INTRODUCTION

It is possible that the use of Information Technology in educational contexts may help to encourage the development of second level analytical processes in children. One aspect of such second level activity is the ability to articulate and use problem solving processes. This paper describes the work of a project in Nottingham which is investigating ways of relating problem solving to the use of Information Technology (I.T.) in schools.

METHOD

The work in schools involves the generation of a "problem solving climate" followed by the use of I.T. in various curriculum areas. The generation of a problem solving climate is achieved by asking students to articulate and use problem solving processes and is not a difficult task. Even children as young as seven or eight can produce a useful structured set of problem solving processes in group discussions. One group of four ten year olds generated a structured set of processes in their own words as follows:

Ask about it
Think about it
Make decisions about what to do
Try them out, change if necessary

These four processes can be expressed in various other ways and many more can be added. In some ways the idea of always having a "problem" to solve can be a hindrance. A more useful view is that the processes can be applied to dealing with any new situation that needs action. When identified in the classroom these processes can form the basis of an approach to new uses of I.T. and to the use of I.T. in the curriculum. Within the project the important factor is having such processes in the forefront of discussions and available for reporting activities. In project classes teachers ask questions such as: "What ways have you used to find information?", and "What decisions have you reached?". Students in the classes used the structure indicated by the processes to work constructively together and to describe how they have arrived at results.

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THE THREE RELATIONSHIPS

As work has progressed three fairly distinct sets of relationships between the use of I.T. in classrooms and problem solving processes have appeared. The first is where the use of I.T. provides a vehicle for direct problem solving. The second relationship arises when I.T. is used as a tool for making and creating. The third relationship involves using problem solving processes in order to provide an alternative approach to new uses of I.T. by children. More details about these three relationships form the rest of this paper.

DIRECT PROBLEM SOLVING

Some examples of the use of I.T. for direct problem solving are the use of LOGO, adventure games, and using a computer to control and monitor external devices. In this case the identification and use of processes has made it clear when children have engaged in different levels of problem solving activity. It has also helped children to invent their own problems and adventures. One particular example of this relationship occurred with students aged 13/14 in a class working on control activities. One group of three not very able boys had a model buggy that could only go backwards and forwards and a barrier that could go up and down. The motors for each were controlled by computer through a simple LOGO derived programming language. The boys quickly decided on trying to achieve a sequence where the buggy moved up to the barrier, which would then raise, allow the buggy through, and then lower. They then had to work through three stages, first to find and use the combinations of switch commands needed to operate the buggy and barrier, second to convert these into flexible sub-routines, and third to relate these to an analysis of the distances, times etc. needed for their original problem. They structured each of these stages using processes, for the first looking at the brief userguides,analysing the possible combinations of switches, then deciding on a sequence of ordered experiments. It took them about an hour to reach a solution of their original problem, and they were then able to give a detailed verbal description of the stages they had worked through. At the end of the session they were also asked to reflect on their activities with a written comment. One of these (un-edited) was, "I think this project is about solving puzzles and to make things work (move). It is very interesting and fun. It was very hard at first because we had to find what every bit did. Then we had to think about what we was going to do and make a desesion then we did lots of test runs and calculations. In the end we ended up with the car moving forward a gate lifting the car going under and the gate going down". It can be seen that the use of processes and appreciation of levels come clearly through this student's reflection on his work.

MAKING AND CREATING

When I.T. is used as a tool for making and creating it is helpful to add at least one other process to the list. This is to "Consider constraints". The idea being that the use of any technology adds its own constraints to the realisation of particular outcomes. The properties of the medium have to be analysed as a part of the creative activity. Other areas of I.T. involved here are desk top publishing, spreadsheets etc. The use of problem solving processes to do this analysis has given interesting developments. In particular children have been able to articulate the way that the use of the technology affected the outcome of their activities, in some cases they have also been able to specify the concepts involved and what they have learnt. As an illustration of this relationship one of the project classes had different small groups within it taking turns to produce a school newspaper using a simple desk top publishing package. The idea of structuring the production through the processes of gathering information, analysing it, deciding on what to use and how to present it are obvious, but using the processes also led them to other insights about ways of using language. Two insights in particular came from the consideration of constraints. One such constraint was lack of space, as the software only allowed for articles about fifty words long. This led them to consider the style of writing that was suitable and they decided that it had to be the use of as few words as possible to convey ideas. One coined the phrase "punchy style" to describe what was needed. Considering the constraints of the medium lead to the consideration of other constraints such as the need to sell the paper. This meant that articles had to be readable. Another constraint was that headlines were compulsory, so these had to be invented and had to catch the eye. As a result of these considerations each group producing the paper had to edit the work of other children who submitted articles. This idea of children editing the writing of other children would be virtually impossible without this context. Working in a problem solving climate enabled the children to reach such conclusions naturally, and also to be able to articulate the way that they reached them. The children were asked to reflect on their experience of producing the paper and what they thought they had learnt. Most comments were about the setting out and production aspects, but there were also many which said that they thought that they had learnt to work more systematically and to think more clearly.

NEW USES OF INFORMATION TECHNOLOGY

The third relationship involves using problem solving processes in order to provide an alternative approach to new uses of I.T. by children. At present the method of approach to new technology in classrooms can be very structured with an emphasis on "training" rather than understanding. Many published userguides give step-by-step instructions without any explanation of principles. The result is often a lack of flexibility in the learner because of a lack of basic understanding. In a problem solving climate the use of new technology is seen as a situation to be dealt with by the usual methods of finding information, thinking, making decisions etc. Students learning to use new technology in project classes expect to find information from the teacher, userguides and each other. They expect to use trial and error for some details but tend to look for general principles. The learning process is therefore more natural and relates easily to using the new feature in contexts.

CONCLUSION

One aspect of human development which will be of increasing importance is the ability to be flexible in a rapidly changing society. One way of encouraging such flexibility is to place more emphasis on the use of second order analytical activities in students. This project is investigating one way of helping to achieve this by fostering the relationships between problem solving and the use of I.T. in classrooms.

THINKINGLAND - AN INTENTIONAL LEARNING PROJECT

The Database and the Culture

P Skillen

ABSTRACT

The ThinkingLand project focuses on the development of an environment that will promote Intentional Learning among students. Intentional learners take an active role in pursuing knowledge about, and in regulating, their own learning and thinking strategies. The **Thinkingland Database** is central to this environment. It is a program (written using HyperCard) where students can think about and record their own thoughts about their plans, bugs, questions, triumphs, and reflections regarding a task. The students build a collective database by entering data into fields of their choice. The students' novice behaviours are, therefore, *scaffolded* by prompts, or these database fields, that might be characteristic of experts. Such a prompt (field) might be *"The steps I plan to follow are..."* or *"A similar task that I have had before is..."* . In addition to entering data, of course, students can access other students' information. They can browse, or query, the database to see how their peers have approached tasks. Think about this for a moment. Here is a situation where, not only do students get a chance to see what other peoples' final products look like, but they get an opportunity to 'glimpse' the process that other students go through in performing a task. The initial plans are available to see. Any changes in the plans are made explicit, as are the reasons why. And so on. As focal as the ThinkingLand Database/Bulletin Board is to the environment, however, the overall culture is essential to its effectiveness:

- **Thinking** must be a highly valued activity. Not just **thinking hard**, but thinking about thinking, in addition to the task.
- The students must be engaged as **coinvestigators** into the processes of thinking.
- Students must see **results** from their extra efforts.
- Teachers must **model** intentional learning as a matter of course.
- Other explicit strategies are used to teach students about thinking (Afterbugs, Watch Me Think, Go With The Flow, etc.).

ThinkingLand is currently being used with students learning the **Logo** language (LogoWriter) at the Junior/Intermediate grades in six sites across North York and area. Although specific to Logo at the moment, a cross-curricular ThinkingLand tool is evolving from this research. This will have more general application in other subject areas.

The project has arisen from the literature on Intentional Learning (Scardamalia & Bereiter, 1983), metacognition, expert/novice strategies, artificial intelligence, Logo and from experiences in the classroom and as teacher trainer.

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USING COMPUTER BASED PROBLEM SOLVING SOFTWARE IN SCHOOLS: COGNITIVE AND METACOGNITIVE OUTCOMES

Kwok-Wing Lai

ABSTRACT

This paper documents a study investigating the effects of computer based problem solving software on the cognitive and metacognitive skills of young learners when different training procedures (instruction and non-instruction) were used. 18 students (aged 13-14) from a New Zealand city school participated in eight one-hour sessions in late 1988 and were randomly assigned to one of the three training groups. Four software items running on Apple IIe computers were used. Pretests and posttests measuring metacognitve awareness, problem solving abilities, and a number of mathematical concepts were conducted. Results showed that the instruction groups had a significant improvement in metacognitive awareness, and the ability to evaluate solutions. There was also an overall improvement in achievement in the mathematical concepts.

INTRODUCTION

With the advent of microcomputers and related technologies to the classrooms, computer based problem solving software could be used to enhance learners' cognitive and metacognitive skills. The impacts of problem solving software on the learners may have been greater if they are aware of the problem solving procedures or strategies embedded in the training exercises. According to Brown and her colleagues (ref 1), there are three types of training programs implemented by educators. The first type is called blind training where the learners are induced to use a strategy without concurrently understanding the significance of that activity. The second type is called informed training where the learners are both induced to use a strategy and also provided some information as to the significance of the activity. The last type is called self-control training where the learners are not only instructed to use a strategy, but are also explicitly instructed how to employ, monitor, check, and evaluate that strategy. Of these three training procedures, the self-control training method is by far the most successful one in terms of enhanced performance and transfer. As problem solving skills could be transferred to novel situations only when the principles on which they rest are made explicit to the learners (ref 2), the self-control training method may also be more effective in a computer based problem solving environment.

One way to induce the learners to monitor and evaluate their strategies in training sessions is to encourage them to think aloud and verbalize their ideas and strategies. As suggested by Lochhead (ref 3), students could work in pairs in a problem solving exercise where one partner thinks aloud in solving the problem while the other listens and asks questions. On subsequent problems the partners change role. In the exercise both the problem solver and the listener are forced to evaluate their strategies and also to monitor their solutions closely. Verbalizations help learners elaborate and externalise ideas and strategies and reflect upon them.

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The present study aimed to evaluate the cognitive and metacognitive implications of computer based problem solving software. Specifically, this study investigated the implications of computer based self control training procedures on the acquisition of metacognitive awareness and problem solving skills for young learners. The effects on achievement were also investigated.

METHOD

Subjects

18 Form 3 (aged 13-14) boys from a New Zealand city school participated in this study. These students had received some formal instruction in computer literacy, but had no knowledge on the software being used in this study. They met twice a week after school and worked in pairs for an hour over a period of four weeks. An extra two-hour instruction was given to the instruction groups. Four computer based problem solving software items (The Factory, Building Perspectives, Right Turn, Super Factory, all published by the Sunburst Co.) running on Apple IIe computers were used in this study. These software items were selected because they purported to teach a similar set of problem solving skills and mathematical concepts.

Procedures

The participants were randomly assigned to one of the three groups. In the first group (non-instruction group) they received no extra instruction other than the operation procedures of the software items. Participants in the second group (instruction group) received instruction on how to understand the problems, and how to select strategies to solve the problems in each software package. They were also instructed to reflect upon their problem solving strategies and monitor their solutions. Participants in the third group (instruction group) received the same instruction as the second group, but in addition, in each pair one student was asked to work on the problems first whereas the other member monitored his progress and raised questions. They took turns as problem solver and questioner.

Data Collection

1. Interview - Pre- and Post-interviews were conducted to measure the metacognitive awareness of the participants on problem solving. Four questions were asked: (1) What does a good problem solver do in solving a problem? (2) What is the first thing you do when you are given a problem to solve? (3) What do you do when you are stuck? and (4) What do you do if you think you have found a solution? The interviews were transcribed and coded, as suggested by Ericsson and Simon (ref 4). All 18 participants' responses to each of the four questions were examined and categorized to determine the range of responses of each question. Three rating categories on metacognitive awareness were decided: (1) problem solving involves conscious processing of the problem; (2) problem solving involves selecting strategies; and (3) problem solving involves continued monitoring and evaluation. A 7-point Likert-type scale was developed to differentiate the range of responses for each of these 3 categories (ref 5).
2. Problem Solving Task - The participants were asked to solve 4 problems (Tower of Hanoi type) verbally at the beginning of the study and 4 similar ones immediately after the study. The think aloud protocols

were examined and scored according to whether the participants provided answers to 12 questions. These 12 questions were grouped under three categories of problem solving skills : (1) the ability to understand the conditions and structure of the problems; (2) the ability to use appropriate problem solving strategies; and (c) the ability to monitor and evaluate the solutions.

3. Achievement Test - Two parallel sets of achievement tests were administered to the participants, one before and one immediately after the study to measure the effects of the software items on a number of mathematical concepts. The test items were selected from mathematics textbooks and exercises provided in the software packages. They were validated by the participants' mathematics teacher.

4. Participant's Log - Each participant was required to keep a log to record and reflect upon what they have learned.

RESULTS AND DISCUSSIONS

A preliminary analysis on the data obtained from the interviews, problem solving tasks and the achievement tests was conducted and is reported here. During the study it was found that the participants in group 3 had great difficulties in understanding how to question their partners and failed to act as questioners. They also had difficulties in thinking aloud. Because of that, this group experienced virtually the same treatment as the second group, where instructions on problem solving procedures and skills were given. Thus it was decided to collapse Groups 2 and 3 data to form one instruction group.

Metacognitive Awareness

MANOVA repeated measures procedures were used to test the differences in metacognitive awareness between the instruction and non-instruction groups. A significant overall improvement in metacognitive awareness was identified ($F=139.00$, $p<0.001$) and all three rating categories contributed to the improvement. With regard to group differences, a significant difference between the instruction and non-instruction groups was identified for the total scores of the interviews ($F=6.82$, $p< 0.01$), favouring the instruction group. A further analysis revealed that of the three metacognitive categories identified from the interviews, group differences were significant both in conscious processing ($F=10.96$, $p<0.01$) and continued monitoring ($F=6.93$, $p<0.05$), favouring the instruction group. The results clearly showed that when explicit instruction on metacognitive skills was provided, and when the learners could practise these skills in a computer based learning environment, their metacognitive awareness would be facilitated, especially in attending to the structures of the problems, and monitoring the solutions. The reason that there was no improvement in the selection of problem solving strategies may be due to the fact that the participants did not have a large repertoire of problem solving strategies and therefore there was no need for them to attend to the selection of strategies. It was also evident that these participants were used to following problem solving instructions and were not able to ask questions on their own.

Problem Solving Abilities

The problem solving tasks were designed to measure the effects of the computer based training procedures on the problem solving abilities of the participants. A oneway analysis of variance on the posttest scores, taking the pretest scores as covariates was conducted for each of the three problem solving abilities. Significant difference was identified only in the third category - the ability to monitor and evaluate solutions ($F=4.77$, $p<0.05$). The instruction group had a higher score on the ability to monitor their solutions. This group also had a higher score on the ability to understand the problems, but the score was not significantly different from the non-instruction group ($F=3.11$, $p=0.098$). Although the instruction group had significant improvements in metacognitive awareness of problem solving, the training procedures had little effect on the selection of problem solving strategies. There was a problem of transfer because the problem solving skills the participants had learned from the computer software had to be assimilated before using them to solve new problems. The lack of practice (only 10 hours) may contribute to the limited transfer.

Mathematical Concepts

The problem solving software used in this study purported to teach certain mathematical concepts: e.g. the transformation of two and three dimensional objects. The achievement tests were designed to measure these outcomes. A paired t-test (one tailed) on the pre- and post-test scores was conducted and a significant difference was identified ($t=1.98$, $p<0.05$), showing an overall improvement in achievement for all three groups. However, no significant difference was identified between the instruction and non-instruction groups. The result showed that the computer software was effective in helping learners to acquire certain mathematical concepts.

CONCLUSIONS

To use computer based problem solving software effectively in schools, it is essential to provide learners with explicit instructions on how to understand the problems, and also how to plan and evaluate the problem solving strategies. It is also important that they are aware of the monitoring procedures. The computer based learning environment is particularly conducive to enhancing cognitive and metacognitive skills since it provides the learners ample opportunities to practise these skills and receive immediate feedback. 'Think aloud' exercises may further enhance these skills. It is unfortunate in this study that young learners were unable to question and elaborate on their problem solving strategies verbally. The effects of thinking aloud on problem solving was therefore not tested. Instructional procedures to train learners to think aloud in a computer based learning environment should be developed and evaluated in future studies.

ACKNOWLEDGEMENTS

This study was funded by the Otago Research Grant. The author is grateful for the support of Mr Robert Mace and Dr Bruce McMillan.

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Develop Thinking Skills Without Programming Codes

B Michaud

ABSTRACT

The computer is clearly an excellent vehicle for expanding a student's thinking processes and writing skills. It is however, only practical when the teacher is not required to invest an enormous amount of preparatory time in computer training. This session will introduce a tool that facilitates a teacher's task but also produces outstanding results.

A growing number of teachers are now using Scenario software to create new and innovative classroom activities as well as to augment the efficacity of their traditional teaching approaches. Scenario is a tool that requires no previous computer experience nor programming codes.

In this session Professor Michaud will illustrate how teachers can develop their students' thinking and problem solving abilities by giving students the opportunity to create their own individual and group programs integrating text, graphics, music and voice. By building animations, menus or electronic bulletin boards, for example, students stretch their natural aptitude for organization, planning, detection, prediction, etc.

Professor Michaud will demonstrate, by building a program with Scenario software, how students at any level form elementary school post-graduate level can, by using their own language (English, Spanish or French) create and run his/her own computer program.

He will also demonstrate how Scenario can be effectively used to stimulate creative expression, exchange of ideas as well as facilitate interactive group projects.

Scenario can be used by students as young as 8 years old as well as by senior level students interested in more sophisticated processes such as answer judgement and simulation.

Professor Michaud has been using Scenario in North American Univesities to introduce students and faculty to computers. He is the author of 'Expressing Ideas With Computers', a book available in French, that explores students' thinking and creativity potential.

TECHBYTE Inc, Canada

LEARNING TO THINK WITH APL (A PROGRAMMING LANGUAGE)

H.A.Peelle*

ABSTRACT

This paper identifies fundamental aspects of APL thinking, illustrates them with brief examples, and raises various issues related to learning mathematics and programming. Aspects of APL particularly conducive to thinking are:

Symbolic Notation
Rectangular Arrays
Global Variables
Powerful Primitive Functions
Parallel Processing
Unique Operators
Uniform Syntax
Compatible Programs
Modular Programming
Generality
Mental Visualization
Idioms, Identities & Proofs

INTRODUCTION

APL is a mathematical notation executable by computer. As an interactive programming language, it has already become succesful in engineering, scientific research, and business applications. The computing profession officially recognized APL as a tool of thought by giving its creator, Dr. Kenneth Iverson, the Turing Award in 1979 (ref 1). Since then, ACM's SIGAPL has conducted a series of professional development seminars entitled "APL as a Tool of Thought" (ref 2). This year's international APL conference carries this as its main theme (ref 3).

The future of APL depends on education. Its potential for teaching mathematics is well known to the APL community, but schools have been slow to change curriculum and pedagogy. Various APL software for microcomputers has existed for years but did not penetrate education. Recently, however, I-APL (International standard APL) has become available as freeware with documentation and instructional materials (ref 4). Now it appears to be time for teachers to begin using APL -- especially as a tool for students to think with.

Previous studies of APL thinking and related projects were described last year in an introductory paper (ref 5). This paper presents specific aspects of APL thinking, drawn from a survey of APL thinking (ref 6), in order to further interest among educators.

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ASPECTS OF APL THINKING

Symbolic Notation

To begin with, APL is a highly symbolic language. Known for its unusual character set, APL has many different symbols: ⍞ ⎕ (input/output) ( ) (parens) ' (character data) ⍝ (comments) ∇ (begin/end program) → (branch) ← (assign) . (decimal point) : (labels) ; (index separator) and + - × ÷ ⋆ , < ≤ = ≥ > ≠ ∨ ∧ ~ ∊ ? ○ ⍴ ⍳ [ ] ↑ ↓ ⍋ ⍒ ⌈ ⌊ | ⊥ ⊤ ⍎ ⍕ ⊖ ⌽ ⍉ ⍟ ⍱ ⍲ ⌹ ! ... (various functions) and / \ ∘. . (operators). (See ref 7 or 8 for an introduction) Many of these symbols come directly from mathematics; a few are borrowed from the Greek alphabet; some replace implicit or inconsistent notation (see Appendix A of Algebra, ref 9); and some are new symbols created for computing purposes. Most APL symbols are mnemonic; that is, their visual appearances suggest their functions or their names relate to placement on the keyboard (e.g. *?* is above *Q*, for Question mark, and is used to generate random numbers). Even at first glance, then, APL is designed to be suggestive. There are, however, no reserved words; that is, any use of natural language -- say, for variable or program names -- requires creating words; otherwise all computations are done with symbols. Thus, APL carries no cultural bias and provides an efficient formal notation, as mathematicians can appreciate. While realizing that not all people are comfortable thinking symbolically, educators must consider training in formal symbol systems as important for the future of a technological society.

Rectangular Arrays

All APL data is structured in rectangular arrays. Examples of numeric data and character data displays are:

4	a scalar (one value)	*B*
2 3 5 7	a vector (list)	*AEIOU*
1 2 3 4 5 6 7 8	a matrix (table)	*ROW*1 *ROW*2

Higher dimensional arrays include data cubes (several tables, displayed sequentially), etc. Rectangular arrays are a common way to organize data for both human interpretation and machine data processing. They are easy to learn and to think with. Further, one can envision and manipulate APL data as a whole (see Parallel Processing and Mental Visualization).

Global Variables

A global variable in APL is created by using the ← symbol. Either numeric or character data may be structured into a scalar, vector, matrix, etc. -- without need for prior declarations. APL's dynamic storage allocation liberates the programmer from worry about such housekeeping. For example: *A*←4 assigns the value 4 to the name *A*. A variable name may be a descriptive word, as in *PRIMES*←2 3 5 7 or an abbreviation such as *P* ; the choice reflects one's programming style. The value(s) assigned remain globally accessible until the variable is explicitly re-assigned; so, using a variable does not change its value: *A*+1 is 5 but *A* still contains 4, unless *A*←*A*+1 , then *A* is 5. This is preferable to using the equal sign for assignment (as in most programming languages) since A can never be equal to A+1! Further, note that an APL variable can be assigned the result of any computation: *A*←6×7 Assigning a global variable can be thought of as putting something valuable into a box (or into memory) for possible use later on. The APL symbol ← itself suggests this.

Powerful Primitive Functions

APL provides a rich resource of primitive functions. Some 60 different functions are on the keyboard (see symbols above). While this might seem like a lot to learn, one can always begin by using a subset of primitive functions and then learn more as needed (ref 7).

Most are ambivalent; that is, one symbol can perform two different (but usually related) functions. For instance, ÷ is reciprocal (÷4) or division (3÷4) depending on whether it has one or two inputs. At the same time this double duty makes economical use of symbols, it systematizes thinking about functions and allows them to be evaluated uniformly (see Uniform Syntax).

APL functions may be composed with each other naturally: 10×+/÷!⍳10 (10 times the sum of reciprocals of factorials of the integers from 1 to 10). Each individual function passes its result to the next function. This is often called "functional programming".

In thinking about a problem with APL, it can be reassuring to know that there is probably a powerful primitive function which will do a significant part of the job. For example, ⍋ produces a permutation vector, which when used with indexing, *V*[⍋*V*] , sorts a vector *V* into ascending order. And, ⌹ solves simultaneous linear equations directly. This puts great power at one's fingertips and can help students focus on the problem at a higher level. Nevertheless, this may create a dilemna for the teacher who insists that students know how a function works before using it.

Parallel Processing

Certain APL functions apply to each element in an array: *PRIMES*-1 is 1 2 4 6 . (Recall *PRIMES*←2 3 5 7 earlier) Such "parallel processing" may be close to the way we think (or at least, think we think) -- after all, neural networks in our brains are highly interconnected. Further, APL appears ideally suited for new parallel computer hardware such as IBM's 7090 Vector Facility and The Connection Machine (ref 10). By treating an array of data as a whole entity, machine architecture is advancing in sync with APL thinking.

Unique Operators

APL is unique among programming languages especially because of its "operators". (Operators take functions as input and produce new functions.) For example, the Sum function `+/` is produced by the `/` operator and the `+` function, which can then be applied to data: `+/2 3 5 7` is 17. The same operator `/` can accept other functions as well: `×/2 3 5 7` is 210. Other APL operators are: `\` "scan", `∘.` "outer product", and `.` "inner product". Examples: `+\V` gives cumulative sums; `P∘.×R∘.*T` gives a 3-dimensional table of compound interests with several principals P times several rates R raised to several powers of time T; `M1+.×M2` gives the matrix product of M1 and M2.

Since APL operators can accept many different functions and produce new "derived" functions, this greatly increases the (already large) number of APL functions. Further, the existence of operators provokes some new ways of programming. Most notably, APL operators often obviate need for control structures such as FOR...NEXT and DO...WHILE because they produce functions which apply throughout an array in one fell swoop. This enables the programmer to concentrate more on the overall algorithm rather than get bogged down in bit-at-a-time thinking about details of looping.

Uniform Syntax

A single rule governs the evaluation of any APL expression: every function uses the entire subexpression to its right (subject to parentheses, which dominate in the usual way). In an expression with several functions, such as `10+2×4-1` , this means 10 plus the result of 2 times the result of 4 minus 1, so 4-1 is executed first, then 2x3, then 10+6. This conforms to common notation for function composition in mathematics: f(g(h(x))) is `F(G(H(X)))` -- or just `F G H X` -- in APL. Yet it clearly differs from conventional function hierarchy: x and / before + and - etc. In APL, this rule applies uniformly to <u>all</u> functions, whether primitive or defined (programs). The idea that all functions have equal precedence in APL (and that order of evaluation depends solely on position) is a major reconceptualization which may take time to adjust to. But it's worth it -- at least because it gains access to many more functions without having to remember which to do first.

APL's rule also applies consistently, whether a function is "monadic" (with one input) or "dyadic" (with two inputs). Reciprocal (`÷`) is monadic and so is Sum (`+/`) but Plus`+` Minus `-` Times `×` and Divide `÷` are dyadic. Students can learn this distinction simply by looking to the immediate left of a function symbol: if there is data there, the function is dyadic; if not, it's monadic.

While APL syntax is simple and uniform, it is controversial because it differs from (albeit somewhat inconsistent) conventions in mathematics. Adopting APL in schools would entail thorough reform of math education (which seems to be timely).

Compatible Programs

If a programmer wants to put expressions together in sequence to accomplish a larger goal, she may write "programs" -- that is, define her own functions in APL. For example, a program to compute the average of numbers:

```
        ∇ R←AVERAGE N
   [1]    R←(+/N)÷(ρN)            (See ref 5 for explanation)
        ∇
```

Such programs behave like primitive functions and may be used in expressions along with them: `10×AVERAGE 2 3 5 7` is `42.5` . This compatibility effectively extends the range of primitive functions and allows one to think of programming as a constructive process of defining functions.

Modular Programming

APL programs are often short -- indeed, APL is notorious for "one-liners" -- typically composed of both primitive and defined functions ("sub-programs"). They can be built and analyzed in either a bottom-up or top-down fashion, or even ad hoc; they can be more easily designed and tested as independent programs; then, when debugged, they can be used modularly in different ways for different purposes. APL seems to encourage thinking in "mind-sized chunks". Programming thereby becomes the art of developing modular sub-programs which can be assembled into more complex programs. This enables one to think about a subject area as a collection of modular functions. (See ref 11 for examples)

Generality

Because APL itself was carefully designed with generality in mind, it promotes general thinking. Firstly, APL primitive functions are general-purpose: they were selected because of their usefulness across a variety of disciplines. Secondly, the primitives themselves are generalized: they apply to arrays in the same way as for single values, and they handle special cases such as empty arrays. Thirdly, when one writes a program to solve a particular problem, often it is inherently general enough for multiple cases. For example, this program for converting Fahrenheit to Celsius

```
        ∇ C←CONVERT F
   [1]    C←(5÷9)×(F-32)
        ∇
```

works for one value (`CONVERT 212` is `100`) or a list of values (`CONVERT 32 167 212` is `0 75 100`) or any array of values.

Further experience programming in APL confirms the value of writing general programs in the first place in order to avoid their subsequent degeneration via repeated patching.

Mental Visualization

Thinking with APL seems to involve some mental visualization.

Problem-solving can be seen as a process of generating and manipulating an array: choose an appropriate (array) representation and apply selected APL functions -- progressively moving values around in the array until a solution is found or (if it is contained within) so it can be extracted. For example, a program to compute divisors:

```
          ∇ ALL←DIVISORS N
     [1]    ALL←(0=ALL|N)/ALL←⍳N
          ∇
```

DIVISORS 10 begins by generating a list of possible divisors (⍳10 is 1 2 3 4 5 6 7 8 9 10), then finds the remainders of these integers divided into 10 (0 0 1 2 0 1 2 3 4 0), then compares these with 0 (1 1 0 0 1 0 0 0 0 1, where 1 is equal and 0 is not), and finally selects out of the original list (⍳10) the result: 1 2 5 10.

Other examples of mental visualization for more sophisticated problems are discussed in ref 12.

Idioms

APL programmers soon learn to recognize short, commonly used expressions ("idioms"). This affects how one thinks since such idioms become reliable building blocks which do not need to be scrutinized each time they are used. For example, ⍳⍴*V* is a simple idiom for generating all the indices of a vector. It is usually used as a chunk, without thinking about it step by step: if *V*←85 55 90 70 60 , ⍴*V* is 5 and ⍳⍴*V* is 1 2 3 4 5. Another idiom is ⍋⍋*V* . This idiom produces rankings (indices of the "pecking order" in a vector (where 1 is the lowest, 2 next larger, etc.) and is rather challenging to understand. For example, ⍋*V* is 2 5 4 1 3 (indices which will sort V into ascending order) and ⍋⍋*V* is 4 1 5 3 2 (the rankings). (See ref 13 for a catalogue of hundreds of popular APL idioms)

Identities & Proofs

APL lends itself to expressing algorithms in alternative ways. This naturally leads to questioning if two expressions are equivalent. Finding identities and proving equivalence is good intellectual exercise. (See Elementary Analysis, ref 9) While such recondite thinking may not be a practice of many programmers, the opportunity is there in APL.

Other Aspects

These are but initial aspects of learning to think with APL. Other aspects of APL thinking not discussed here include: the effects of interactive computing (vs. mental simulation), the concept of a workspace, influences of APL system features (such as TRACE and STOP controls), the role of imagery and metaphor, and programming tricks. Further aspects involve actual thinking processes, misconceptions, metacognition, problem-solving strategies, and programming techniques -- all of which beg for study and explication.

CONCLUSION

APL provides tools which are well-designed for thinking. Learn to think with APL!

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SYSTEMS BASED ON STUDENTS'ERRORS : A REALISTIC WAY TO USE A.I. IN EDUCATION

Bernard DUMONT*

ABSTRACT

After presenting difficulties in creating Intelligent Tutoring Systems (ITS), FRACT-1 is described as a system based upon students' errors in calculus of fractions obtained from two large inquiries in France. Two ways of using it are proposed; one for researchers in didactics and another for teachers training. In the future, it is possible to imagine how FRACT-2 could be used directly by students to diagnose their errors and to understand their wrong reasoning.

DIFFICULTIES TO CREATE USEFUL I.T.S.

In every kind of Expert Systems, the most important value is coming from the "expertise". In education, alas, pedagogical expertise is rare. It's difficult to describe it as rules. Progress in technology are not sufficient to let us see how to go from poor C.A.I. to good I.T.S. We need to know more about learning process and didactics before writing useful tutorial systems. LEPPER and CHABAY (ref. 1) would like more research on human tutoring before speaking about artificial one. They regret, and so do I, that the only information taken into account in actual I.T.S. are cognitive knowledge on the domain. They emphasize the importance of psychological and affective aspects of the relationship between a teacher and a student.

THE STATUS OF ERRORS IN EDUCATION

Our work is based on a "pedagogy of error". When a student produces an error, it is, usually, a valuable information about his/her knwoledge, even better than a correct answer (that could come from an uncorrect reasoning). A recent inquiry (ref. 2), at the end of primary school and at the beginning of secondary school, proves that most of the teachers of math don't take care of errors : they just aim at the production of the correct sentence without analysing these errors. Students are used to assimilate a wrong answer with a fault. They try to forget it more than they try to understand its origin. They feel guilty. They are not used to see the positive aspect of producing an erroneous reasoning and how it can help to get a deeper knowledge of the domain.

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FRACT-1

FRACT-1 is a piece of software built with N EXPERT, which is a shell of Expert System with object oriented language facilities. It contains two types of rules : correct rules on calculus of fractions, mal-rules, i.e. uncorrect transformations (fig. 1). FRACT-1 also contains meta-rules on wrong strategies, links about correct and mal-rules, ...

Mal-rules and meta-rules are the result of two large inquiries on more than 3 000 French adolescents (ref. 3 and ref. 4). Errors on fractions have been observed and the frequencies of their appearence.

From an exercise, for example, a sum of two fractions, and an uncorrect answer, FRACT-1 is able to propose one, or more erroneous paths, i.e. a succession of correct and mal-rules,"explaining" this error. So, from $\frac{31}{18} - \frac{11}{4}$ and the wrong answer $\frac{7}{9}$, FRACT-1 has found 6 paths (fig. 2).

First, there is a change of operators (from "-" to "+"), then :

- two ways to find the numerator
  1) (31 + 11)/6 = 7
  2) "cross-product" and division by 46 (unexpected!)
     (31 x 4 + 18 x 11)/46 = 7
- three ways to find the denominator :
  1) keep the first denominator and divide bt 2
  2) multiply the denominators and divide by 8
  3) calculate the L.C.M. and divide by 4.

A TOOL FOR RESEARCHERS

To be able to find such erroneous paths could help researchers when calculus are too numerous to be done by hand; especially if it's necessary to derive from an exercise as $\frac{A}{B} + \frac{C}{D}$ those obtained simplifying A and B or C and D, or both, and those obtained changing operators. Even if the program doesn't give an immediate result, it could be used to find, exhaustively, erroneous paths. It's also a way to explain unexpected students' results.

A TOOL FOR TEACHERS TRAINING

Teachers are not used to work on students' errors. They are prepared to tell how to solve problems, how to go to the right answer. They are not prepared to diagnose, explain and take advantage of errors. They usually don't know that errors can be understood as mal-rules, i.e. as wrong "theorems" coming from correct ones, and that errors can be "formalized". Already, the authors of BUGGY (ref. 5) wanted their software on substraction to be used for teachers' training. In its actual version, FRACT-1 can be directly used by teachers. The user-friendly approach of N EXPERT and MacIntosh allows them to "see" the erroneous paths found by FRACT-1 but, also, to go through the rule base (fig. 3), even to modify some of the rules (fig. 4).

FRACT-2 : FOR THE FUTURE

We are still working on a new version, FRACT-2, which could be used by students for self-evaluation. Our research is presently oriented to remediation of errors : how students are convinced of having made a wrong reasoning? How can they change their mind about mal-rules? Until we have no answers to such questions, we can't build a program useful for students because we need to understand the depth of errors before giving them the useful help.

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Règle R.1

Si $F = \frac{a}{b} + \frac{c}{d}$ alors $F = \frac{a+c}{b+d}$

Fig. 1 : Example of mal-rule

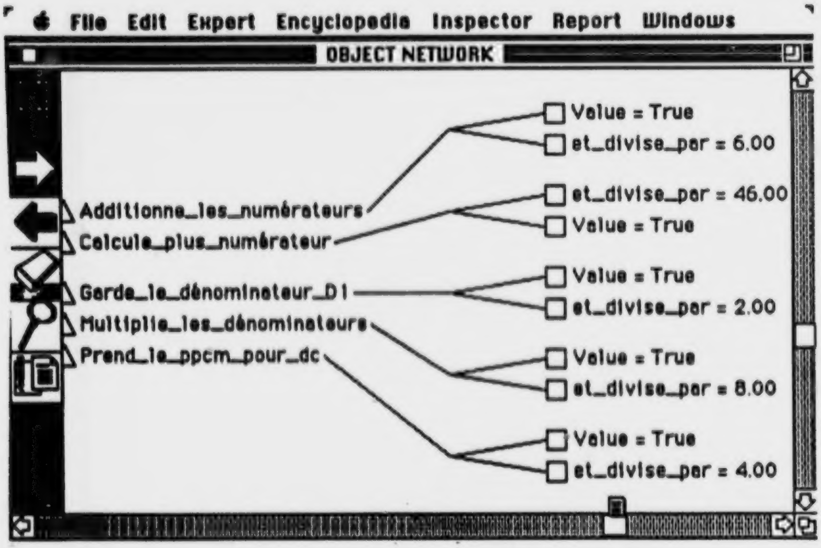
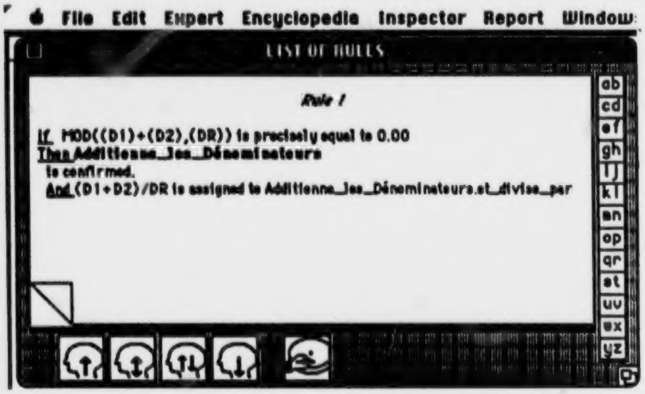

File
Edit
Expert
Encyclopedie
Inspector
Report
Windows
OBJECT NETWORK
Additionne_les_numérateurs
Calcule_plus_numérateur
Garde_le_dénominateur_D1
Multiplie_les_dénominateurs
Prend_le_ppcm_pour_dc
Value = True
et_divise_par = 6.00
et_divise_par = 46.00
Value = True
Value = True
et_divise_par = 2.00
Value = True
et_divise_par = 8.00
Value = True
et_divise_par = 4.00

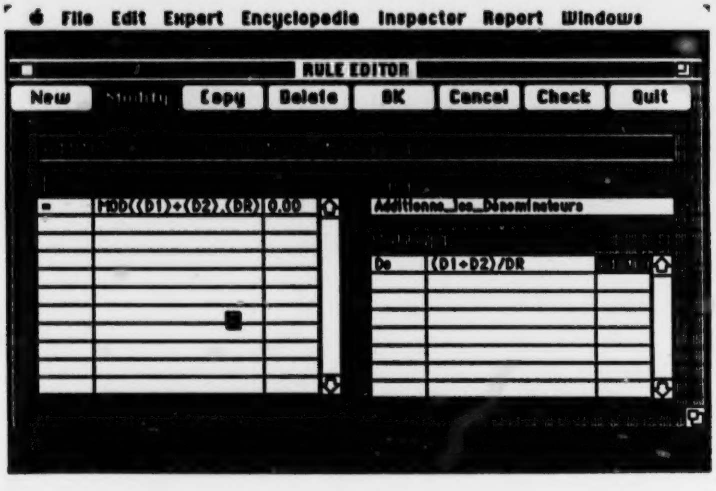
Fig. 2 : Paths found by FRACT-1


File
Edit
Expert
Encyclopedie
Inspector
Report
Window
LIST OF RULES
ab
cd
ef
gh
ij
kl
mn
op
qr
st
uv
wx
yz

Rule 1

If MOD((D1)+(D2),(DR)) is precisely equal to 0.00
Then Additionne_les_Dénominateurs
is confirmed.
And (D1+D2)/DR is assigned to Additionne_les_Dénominateurs.et_divise_par

Fig. 3 : Example of mal-rule on NEXPERT


File
Edit
Expert
Encyclopedie
Inspector
Report
Windows
RULE EDITOR
New
Modify
Copy
Delete
OK
Cancel
Check
Quit

= MOD((D1)+(D2),(DR)) 0.00

Additionne_les_Dénominateurs

Do (D1+D2)/DR

Fig. 4 : Editor of rules on NEXPERT

INTERACTIVE VIDEO ADVISOR: AN EXPERT SYSTEM FOR INTERACTIVE VIDEODISC CONFIGURATIONS

G. W. Orwig[*], A. E. Barron[#]

ABSTRACT

An expert system called Interactive Video Advisor (IVA) has been developed at the University of Central Florida to provide system planning expertise for instructional designers and project managers. It analyzes the delivery requirements of an interactive video application and makes recommendations toward specific system characteristics such as input devices, graphics cards, and image overlays. Funding for the initial research on this project was provided by the University of Central Florida Institute for Simulation and Training.

THE ORGANIZATIONAL DOMAIN

Instructional systems designers carry out a variety of activities that collectively lead to the development of instructional materials and appropriate delivery systems. While the duties of individual designers can vary widely, the procedures related to the development of new instruction can almost always be broken down into the broad areas of analysis, design, development, implementation, and evaluation/revision.

The development phase includes a process for media selection which is essential to ensure the eventual success of the instruction being developed. When the medium for instruction is carefully matched to the instruction at hand, development and delivery costs can be minimized while learning efficiency can be maximized. When this process is handled carelessly, development and delivery costs soar and the efficiency of the learning process can suffer.

Once the medium has been selected, the final process of specifying the complete delivery system is usually simple because many forms of media have become reasonably standardized. For example, if color photographic slides are to be used, it is taken for granted that they will be 35 mm and will work on any common slide projector.

THE SITUATION AND THE NEED

Recently, many instructional designers are discovering that the proper identification of the appropriate medium can sometimes be only the beginning of the process of developing the delivery system. This is especially true with the newer, complex technology of interactive video, which is actually an amalgamation of many media. It can function in much the same way as photographic slides, slide-audio, motion picture, video tape, digitized audio, video, or data, and so forth. Since interactive video is driven by a computer, all of the attributes of computer

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assisted instruction are also available. Due to the complexity of the medium, its recent development, and its rapid evolution, many instructional designers are not able to make rapid and efficient decisions on the precise IVD delivery system configuration needed for the instruction under development.

Consultants are available for such decision analyses; however, as with all technology, they are expensive. Also, the consultant may be associated with one particular company of hardware and/or software and make recommendations based on those associations, rather than impartial judgments. An alternative solution is that a company may decide to undertake its own research to select a system. This procedure will generally take weeks, even months, and require someone with a very good technical background. In reality, the problem is generally solved with a "hit or miss" approach. Many companies and schools have misjudged their needs in hardware and/or software, and therefore ended up with an inadequate or totally useless system.

EXPERT SYSTEM SOLUTION

Based on the situation and need, it was decided to proceed with the development of an expert system that would aid instructional designers and managers in the process of IVD system specification. In this application, the instructional systems design process would have already selected interactive video as the most appropriate medium to deliver the training.

IVA is a rule-based expert system that proceeds through a set of questions or "prompts" in its search for the necessary parameters to match the rules that will allow it to eventually reach its defined goals. The process of creating the knowledge base involved several steps. The initial research lead to the classification of goals into four categories (see figure 1). No matter how the prompts were presented and no matter how the rules were applied, the outcome had to be one mode of visual display connected to one type of CPU with specific input devices and specific output devices.

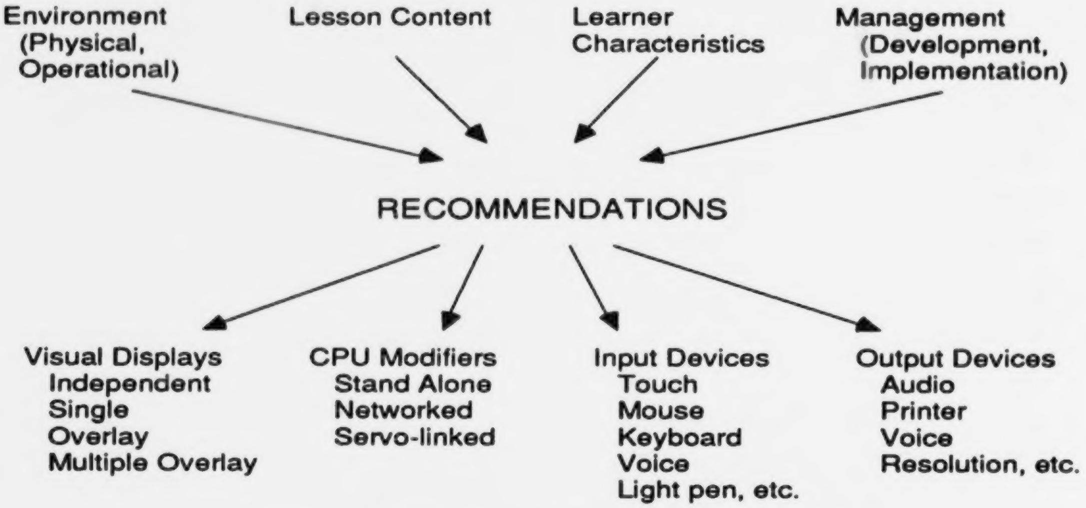
Environment (Physical, Operational)
Lesson Content
Learner Characteristics
Management (Development, Implementation)
RECOMMENDATIONS
Visual Displays
Independent
Single
Overlay
Multiple Overlay
CPU Modifiers
Stand Alone
Networked
Servo-linked
Input Devices
Touch
Mouse
Keyboard
Voice
Light pen, etc.
Output Devices
Audio
Printer
Voice
Resolution, etc.

Figure 1. Categories of Knowledge Base and Goals

Once the goals were clearly identified, the human interview or prompting process was carefully examined. This examination revealed that the human expert consistently asked questions that fell into four organizational categories—the environment, the lesson content, the learner characteristics, and the management considerations. Questions related to these categories would in turn determine the goals. It became obvious that each of the goals could be effected by input from several of the categories (see figure 1).

Decision tables were constructed for each goal area in an effort to clarify precisely which inputs were required to accomplish specific goals. Figure 2 represents sample questions that are incorporated into a decision table for input devices. Decision tables are read vertically, and a blank space indicates that the question is not asked. The ideal outcome is to have only "+" marks in the Action column. This indicates that a clearly defined goal has been reached and that the specified input device(s) is/are needed.

The initial decision tables lead to many modifications. For example, after reviewing the chart in figure 2, it became apparent that if pointing at the screen was not REQUIRED, it ruled out the use of the light pen and the touch screen, even though they could be used in place of the mouse in many cases. Another question was later added to determine whether or not a screen pointing device was PERMITTED.

Detailed Condition Questions

1. Do environmental conditions indicate the potential of damage to exposed cables?
2. Will the learners need to enter words or numbers as responses to questions?
3. Are there targets that the learners will need to select from the screen?
4. Will these targets require the learner to physically point at the screen?
5. Are these targets smaller than a fingertip?

CONDITIONS														
Cable Damage	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	N	N	N
Words/Numbers	N	N	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y
Targets on Screen	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Physical Pointing	Y	Y	N		Y	Y	N		Y	Y	N	Y	Y	N
Small Targets	Y	N			Y	N			Y	N		Y	N	
ACTIONS														
Keyboard				-				+	-	-	-	+	+	+
Touch Screen		+				+				+			+	
Light Pen	-				+				-			+		
Mouse			-				+				-			+

NOTES: A blank space in the conditions indicates the question isn't asked
A "+" in the Actions indicates an excellent match
A "-" in the Actions indicates a partial match

Figure 2. Questions and Decision Table

A more serious problem, however, is the occurrence of a "-" in an action column. This indicates that a particular input device appears to be needed, but that a conflict exists that will create a problem in establishing a clearly defined rule for that set of conditions. For example, if environmental conditions are such that an exposed cable is likely to be damaged (vandalism or what have you), but words and/or numbers must be entered by the learner, there is a conflict. A keyboard is needed, but most keyboards have exposed cables. A major part of the development activity was to resolve these conflicts before rules were created. In the case of the keyboard problem, it was easy enough to add another input device — a keyboard with an armored or enclosed cable.

Once all combinations of the conditions were resolved through the decision tables, rules were established. The rules were of the standard IF-THEN variety. For example:

```
 IF    No Cable Damage
       AND  Words and/or Numbers
       AND  No Targets on Screen
THEN    Input Device = Keyboard
```

These rules became the knowledge base for IVA. Throughout the program, help screens are available to enable the user to make wise selections. In situations where additional help might be needed, short tutorials were added. For example, if the user is unfamiliar with Data On Disc, a tutorial selection becomes available in addition to the brief explanation provided when HELP is sought.

PROJECT SUMMARY AND FUTURE DEVELOPMENT

IVA is a rule-based expert system that helps instructional designers select appropriate delivery system configurations for interactive video projects. The development process first produced a determination of the goals of the system by identifying all common system configurations. The procedures of a human expert were then cataloged to establish the foundations of the knowledge base. Decision tables were constructed from these procedures, and finally the tables were used to create the rules that make up the knowledge base.

IVA currently produces a prescription for the required mode of display, the type of CPU, and the necessary input and output devices. Future development is planned to expand the system to address authoring tools and to access a database of current hardware and authoring software.

A PROTOTYPE COACH TO ASSIST IN THE PROCESS OF DATABASE QUERY FORMULATION

N.R.Armfield*, J.J.Longstaff*

ABSTRACT

Relational database managment is one of the central technologies for managing information in commercial computing, engineering and administration. As such RDBMSs are widely taught in undergraduate and postgraduate courses, and are the subject of continuing research and development.

There is clearly great scope for an intelligent knowledge exposition system to assist users in RDB query formulation. Such a system can be well integrated with conventional teaching techniques. Additionally there is great potential for developing front-end systems for databases which will enable professional people who are non programmers to gain access to data.

This paper describes a prototype intelligent coaching system for SQL query formulation which is currently being evaluated as part of a higher education course on data management.

INTRODUCTION

Relational database manipulation is taught as part of higher education courses to both computing and non computing students. In our institution students spend a substantial part of their courses participating in on-line sessions to support their classroom tuition. It would appear that the teaching of query languages in this way is ideally suited to some form of intelligent teaching system.

It is envisaged that such a system could integrate well with exitsing teaching techniques and would allow the emphasis on

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teaching to shift towards the computer-based methods.

The prototype system is concerned with coaching the user towards successful query formulation. Initially concentration will be placed only on retrieval requests; however the coaching of update requests may be investigated at a later date.

Some work has been reported which bears similarity to elements of our system, for example the ELFS (ref 1) query language paraphrasing system; to our knowledge an intelligent adaptive system for the teaching of query language and relational database concepts has not been developed.

To date most intelligent instructional systems have been largely concerned with areas of mathematics and few have been developed beyond the stage of prototypes. Various factors make the subject domain of SQL unusual and interesting. In order for the user to successfully program a query they need a working knowledge of at least the following areas:

- SQL Syntactic Concepts
- Data Model Concepts
- Application Concepts

An intelligent system must be able to adapt along all of these three dimensions according to the student's ability in each area. It is necessary therefore to maintain a student model for each area.

KNOWLEDGE REPRESENTATION - THE ASSOCIATIVITY NETWORK

The associativity network is based on the semantic network concept and bears similarity to the genetic graph (ref 2).

In the case of SQL domain knowledge the nodes represent SQL keywords, literals and values and the links represent associations and dependencies between the nodes.

The network has several uses:

- Parsing of SQL syntax
- Holding student model information
- Generation of explanations by traversal

Currently parsing is achieved by a hardcoded parser written using the yacc & lex tools of the unix* operating system, eventually it is hoped that parsing may be possible using the SQL knowledge base.

The network associates the SQL concepts together into higher level goals. At the highest level there are two goals: "QUERY" and "UPDATE".

The QUERY goal subdivides at the next level into "SIMPLE QUERY" and "QUALIFIED QUERY", and at the lowest level maps onto the SQL concepts that are needed to perform the goal.

A hierarchy of goals is formed where the use of subsequent concepts depends on a working knowledge of the preceding concepts in the hierarchy.

Student model information is distributed around the network, with each link holding information about the student's performance with particular QL concepts with particular teaching goals.

THE PROTOTYPE

Coaching is achieved by traversing the associativity network to produce timely interventions which are suitable for the student's skill level. Due to space limitations it is not possible to describe the methods by which the network is traversed, but the main features of the dialogue are outlined below.

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* Unix is a trademark of AT+T Bell Laboratories

- **Query language paraphrases**. Natural language (NL) translations of the user's queries are presented. This is used to allows the user to verify their intentions. The user is asked whether the NL query corresponds to their required query, if not a "repair dialogue" can be entered to allow the user to intelligently edit the query until it does match the requirements of the user.

- **Student Response History**. A full history of the student's responses is held. This can be used to quote the student's *own* queries back to them as examples throughout the dialogue rather than giving only system generated examples.

- **Adaptive help menu**. A menu of help options for the three areas of tutoring is available througout the student's session. This dialogue adapts it's options according to the skill level of the student, only presenting material that is suitable and relevant.

The prototype coaching system has been implemented in a modular fashion as several communicating processes running under the unix operating system. Modular construction allows us to use the most suitable language for the particular modules, eg. LISP for the the student models, yacc/lex for parsing and 'C' for the general purpose modules.

The coach acts as a front end to the ORACLE RDBMS communicating via the 'C' Host Language Interface (HLI).

The modules currently in use by the prototype are:

- User Interface Module

- SQL Query Processor Module

- Restricted Natural Language Parser

- Tutor/Student Model Maintainer (containing Assoc. net)

- Query Language Paraphraser

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A MODULAR APPROACH TO A TUTORING SYSTEM

Doris K. Lidtke[*] [*]

ABSTRACT

A prototype of a tutoring system has been developed in five modules. These modules are 1) a user interface, 2) a knowledge base, 3) a response analyzer, 4) a user model and 5) presentation strategies. These modules are not sophisticated in the early prototype, but allow demonstration of the functionality of the training system. Further this prototype development of each module allows 1) incremental sophistication of the tutoring system, 2) experimentation with the various modules to determine where improvements can and should be made , and 3) non-intrusive measurement of learner performance.

Because of the modularity, each segment may be worked on separately to add sophistication to the original prototype. Then experiments can be conducted to test whether the "improvements" in the five modules are practical and effective in improving the tutoring system. The non-intrusive measurement of learner performance will be of great assistance in carrying out the tests.

BACKGROUND

The literature on Intelligent Tutoring Systems (ITS) has grown considerably during the past two years. But there seems to be a general agreement on the necessary components for an ITS. So far, except for trainers which are simulators, the systems generally deal with only one facet of the problem of ITS and are research models. Thus a prototype has been developed in modules to allow for study of each segment.

The prototype includes the following modules
- a. a user interface (HyperCard)
- b. a very simple model of the user
- c. a knowledge base about Buhr Diagrams
- d. a strategy of teaching (tutorial)
- e. an evaluation of user responses.

See Figure 1.

USER INTERFACE

HyperCard became available in November, 1987 and seems to offer important advantages in rapid prototyping. For the research phase of the project HyperCard seems adequate and advantageous.

KNOWLEDGE

The object of the research was to determine the feasibility of using automated training to bring software engineers up to speed in using new productivity tools. Therefore the prototype was developed to teach the user about Buhr Diagrams. The knowledge used is extracted directly from R. J. A. Buhr, **System Design with Ada,** Prentice Hall, Englewood Cliffs, NJ, 1984. Any use of this prototype will require appropriate credits and permissions.

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[*] This research was done while at Software Productivity Consortium, Reston, VA

MODEL OF THE USER

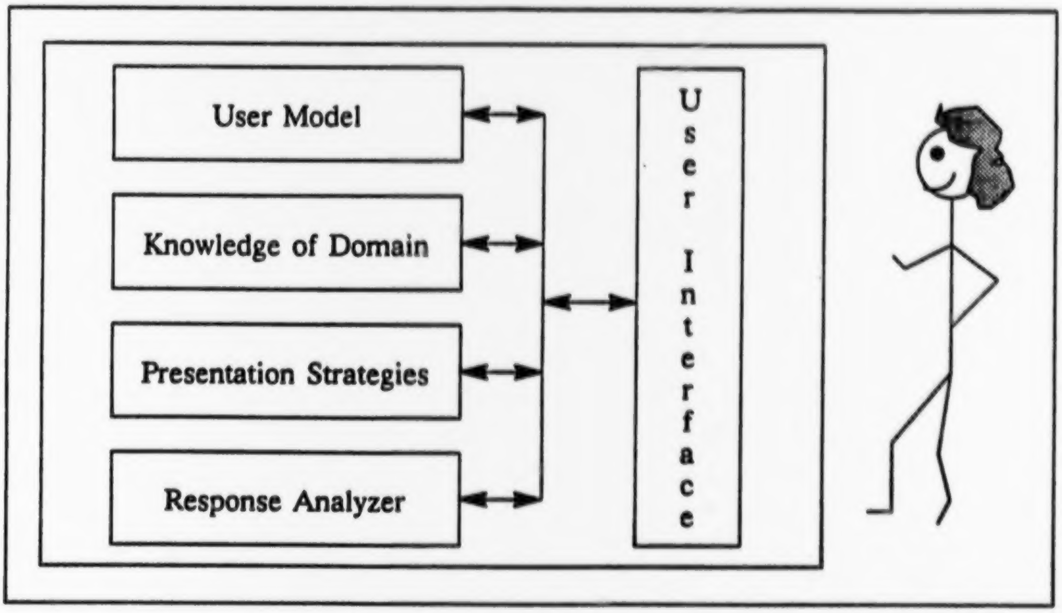
A very simple model of the user is employed. The model has two components: user characteristics and user knowledge. The initial user characteristics are obtained by asking the user to answer a few simple questions the first time the user uses the ITS. the user characteristics are not changed or updated in the prototype since the prototype is not extensive enough to warrant overriding the users' self-description. The knowledge of the user is recorded for each concept that is a part of the knowledge about the tool. For the prototype the user either knows the concept or does not know the concept. There is no method for handling partial knowledge.

PRESENTATION STRATEGIES

The first presentation strategy is tutorial. The knowledge about Buhr Diagrams is the basis for the tutorial. Some portions of teaching by example and questioning have been included to give a flavor of more than one strategy. One of the next steps is to augment the presentation strategies.

RESPONSE ANALYZER

This portion of the prototype is also very simple. Essentially, the responses of the user will be recorded and studied in order to establish how the user is interacting with the ITS. If the user makes inappropriate responses, appropriate or correct responses or corrective information will be presented. This will be accomplished either by displaying the "correct" response or by presenting the misunderstood concept using the section of material which would be presented to a user who is slower that the current user. An attempt will be made to limit repetition of material.



PROCEDURE

Once the initial prototype was designed its evaluation began. Just as with any software, the feedback provides a basis for improving the design and going on to test and develop the affected portions of the prototype. With this type of development the initial prototype allows checking with the potential users to determine if the functionality, general layouts and ways of manipulating the materials, is satisfactory. As the prototype grows and has more substance, information is gathered about each usage of the training materials. The information gathered includes: which frames were used and in which order, the amount of time spent on each frame, and any user responses. From this information it is possible to follow the paths that users take through the material, to determine if some of these paths are similar for several users and what are the implications about the training materials. Do users consistently go off on paths of their own choosing rather that the paths that would be generated for them? Do users tire of one presentation strategy, even one they have indicated that they prefer, in favor of another or a mixed presentation strategy? Do users consistently indicate that they prefer more information in particular areas of the training material? Are there sections of the material which many of the users choose to review?

GOALS

ITS should provide a system which offers the user the assistance desired, neither more nor less. This ITS accomplishes this within limits. Careful evaluation will be needed. To this end an attempt has been made to avoid the difficulties of previous training and support systems. Sobczak etal write that manuals and tutorials usually suffer from one or more of the following problems:

> 1. The system is tailored to only one level of user (usually not simple enough for the absolute beginner but too verbose for advanced users).
> 2. Most systems are inactive unless they are specifically called on. Therefore, the system has no way of keeping track of the proficiency or knowledge of the user for future sessions.
> 3. The information is often given along with other information irrelevant to the present problem. Most computer users prefer brevity and succinctness.
> 4. The information is not readily available when it is needed. On-line manuals usually require that you escape from what you are doing. They also expect you to know what feature and often what particular command you are interested in. Tutorials are even worse for direct information on a particular problem. (p. 128)

FUTURE

Each module of the prototype, except the user interface, will be worked on to attempt to improve it. The knowledge base will be expanded to cover a significant segment of training material. The model of the user will be studied to determine when and if changes in the user model, based on user interaction with the ITS, are feasible and useful. Additional presentation strategy work will include expanding those strategies for which there is currently only meager material and testing mixed presentation strategies. The user response analyzer will be expanded to handle more than the current objective responses. Tests will be run with some users using the ITS and others in small training classes. Comprehension of the material and satisfaction with the training will be evaluated.

Beyond developing one stand-alone ITS for training in the use of a particular software tool, an investigation will be undertaken to determine the feasibility of replacing knowledge about the use of this one particular tool with knowledge about another software tool to attempt to leverage on this training system. If this proves feasible, the next question becomes what are the limits of knowledge bases which could be used for such an ITS.

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AN APPLICATION OF NUDGES TO INTELLIGENT TUTORING

A.C. Jones*, M.P. Thorne**

ABSTRACT

NOLOG is an ICAI system implemented in Smalltalk-80. NOLOG has been developed to provide children with a vehicle for exploring properties of numbers, and comprises a constraint-based programming language for children supported by an Intelligent Tutoring System. In this paper we discuss how we use the idea of NUDGES in a computer-based context to help children debug their NOLOG programs.

We use NUDGES because this approach is more in keeping with the 'child in control of his or her own learning' philosophy than the approaches often adopted in programming assistance tools: we gently *nudge* the child toward spotting his or her errors. We feel that this method offers many advantages: one major advantage being that we thereby minimise the extent to which a child's creativeness and originality are restricted. We discuss how the NUDGES concept is realised in the NOLOG system.

INTRODUCTION

The NOLOG system comprises a constraint-based programming language for children and an Intelligent Tutoring System to assist children in their use of this programming language. The system is implemented in Smalltalk-80 on a Tektronix 4404 workstation. The programming language is somewhat unusual in that it allows children to experiment with sets of numbers by specifying *constraints* which they must satisfy. The set of numbers eventually obtained is displayed on what is essentially a traditional 10x10 number square - in fact we have *planes* (aeroplanes) which visit *islands* and when an island is visited it is shaded in. An important aspect of the NOLOG language is that it was designed with a desire to encourage exploratory programming as was LOGO (ref 1), but in a number-theoretical domain. NOLOG also provides more LOGO-like features: an informal description of NOLOG is to be found in the Proceedings of ECCE'88 (ref 2) including illustrations of typical NOLOG programs *(flight plans)* and the results as they are displayed on the screen.

In this paper we concentrate upon the Intelligent Tutoring System to be found in the NOLOG system: NUDGER. Steve Tipps' book (ref 3) is devoted to *nudges* which should help children in their exploration of the LOGO language. In the introduction the following is stated:

> A nudge is a small push. It's just enough to get you started on an exciting adventure.

We chose to take this idea and implement an Intelligent Tutoring System intended to provide children with as few restrictions as possible in their exploration of the NOLOG language.

OTHER INTELLIGENT PROGRAMMING ASSISTANTS

Our introduction to intelligent programming assistants was through PROUST (refs 4,5). We obtained micro-PROUST (a scaled-down version for the IBM PC) and were disappointed by the limited range of situations in which it was able to produce any sensible response to a bugged program. However the literature concerning the full PROUST system indicates a much larger knowledge-base which is able to recognise a wide variety of student's bugs in a limited range of Pascal programming assignments. Analysis of programs is *intention-based:* PROUST attempts to ascertain what the student intended (described essentially in terms of Goals and Plans) and thus identify departures from correct implementation of the student's intentions. It seems that the output of the PROUST system is what amounts to a user-oriented description of the programming bugs detected.

BRIDGE (refs 6,7) is a system which attempts to take students through a number of different phases in their development of Pascal programs. Students must create plans and transform them into code, the

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BRIDGE system guiding their work at each stage. This system is of particular interest to us because it was implemented in LOOPS - an object-oriented language, although rather different from Smalltalk-80.

Anderson's LISP TUTOR (ref 8) 'is based on a very specific model of how LISP should be learned' (ref 9): it seems that they use an ideal student model, and also information on how a student might err, deviating from this ideal.

IMPART (ref 10) adopts a less rigid approach. This is a LISP coaching system which observes the pupil's interaction with a LISP system, and provides advice only when it believes that the pupil has made an incorrect inference about the behaviour of a primitive LISP function. It seems that only very simple LISP activities can currently be followed in this way, but that useful interaction can be obtained.

For an overview of other work done in the area of intelligent programming assistants, the interested reader is referred to a paper by R.E. Seviora (ref 11). That paper describes some of the different approaches which have been taken with a view to actually understanding programs, and categorises PROUST as a system which performs *program synthesis:* this is the kind of approach taken in the NUDGER system too.

THE IDEAL INTELLIGENT PROGRAMMING ASSISTANT

The ultimate intelligent tutor for use with a programming language intended for exploratory programming would only give guidance which was in some sense necessary to the child. Thus even in their choice of problem children would be gently nudged rather than constrained to a particular problem. We may need to infer the child's *choice* of problem as well as errors in the child's solution to the problem. In fact the situation is more complicated than this because sometimes exploration just involves experimentation with parameters and observation of patterns. In this case we have a program which can be considered correct *by definition* (given that it is syntactically correct) and the child is learning from *observation* of the program's execution.

Clearly it would be very ambitious to attempt the implementation of an ITS which would support such open-ended discovery as we describe, although IMPART seems to contain the beginnings of such a system. Initially we set ourselves two main goals for our research:

- that our system should be able to deal with a reasonable variety of problems of the kind that children would normally be tackling in the NOLOG language; and
- that the intelligent subsystem should be available *on demand*, rather than force itself upon the child, and this system should be able to provide more than simply a single description of the child's programming bug: in other words, that a child should be nudged rather than simply receiving a *bug report*.

NUDGER

In order to illustrate the kind of interaction which NUDGER can provide we deal with a very elementary NOLOG program. NUDGER can provide assistance for more complex programs too: we are using an elementary example only to simplify the discussion.

Suppose our child is attempting to tackle the following problem:

Write a flight plan to visit each island having a number which is a multiple of 2.

There is more than one valid solution to this problem: we only discuss one correct solution and incorrect versions of it in this paper. A correct solution is:

```
visit islands n where
[n mod 2 = 0]
```

Children sometimes have difficulty with the **mod** statement. (As yet we have no significant improvement upon **mod** to offer.) One possible problem is confusion of the order of arguments in the mod statement. For example, a child might have typed:

```
visit islands n where
[2 mod n = 0]
```

But where does the child's problem lie? One child may have very little idea of what the **mod** statement actually means; another may understand it perfectly, but on this occasion he or she made a mistake. Programmers (particularly Smalltalk programmers!) know by experience that their bugs can be due to a number of different basic problems. One possibility is a misapprehension of the semantics of their programming language; another is simply some kind of trivial mistake. Or perhaps the programmer is using a faulty algorithm or logical description of the problem.

Clearly the most appropriate kind of help is not the same for each of these different situations. We propose that the best way to start off might be to ask the child questions such as:

```
What is 4 mod 2? What is 5 mod 3? ...
```

and if the child is able to answer these questions correctly, it is quite likely that he or she will then realise the error, and will need no further assistance to correct the program. We have thus stimulated thought, without being prescriptive about what is a correct solution to the problem. If the child does not answer the questions correctly, and asks for further help, other NUDGES are available on demand which explain **mod** in greater detail.

Suppose that the child had typed:

```
visit islands n where [n = 2]
```

We may have a different kind of problem here: a failure to understand that multiples of 2 are those numbers which when divided by 2 give remainder zero. One particular nudge might be:

```
Don't you want to go to all multiples of 2?
```

But that may not be sufficient. Another nudge might help in these circumstances:

```
2 mod 2 = 0
4 mod 2 = 0
6 mod 2 = 0
 ... can you see a general pattern?
```

PRESENTATION OF NUDGES

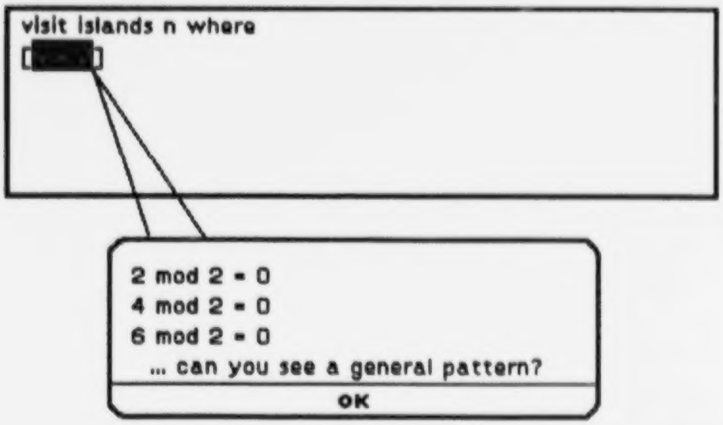
Clearly the manner in which we present a nudge is very important. It should be done in a user-friendly way. In many cases it is useful to adopt some method for indicating the part of the NOLOG program relevant to the nudge. As we have implemented the system in Smalltalk there is a wide range of possibilities. What we actually do is to highlight the relevant part of the NOLOG program (displaying it in reverse video) and then display a *voice bubble* containing the nudge. Thus fig. 1 shows how the last example is displayed on the screen.

ADVANTAGES OF NUDGES

The fundamental advantage of NUDGES is the fact that children are free to use our intelligent system no more and no less than they actually feel is useful. This is very desirable in a system where the whole point is that children should be allowed to *explore*.

In order to provide helpful nudges, it is clear that our NUDGER benefits substantially if it has a clear understanding of the child's program. However, since many of our nudges are *suggestions* (which children are welcome to ignore if they do not wish to follow them) we hope that incorrect diagnosis will have less confusing and catastrophic effects than the provision of a detailed account of a non-existent bug.

Fig. 1. A typical *nudge*



```
visit islands n where
```

```
2 mod 2 = 0
4 mod 2 = 0
6 mod 2 = 0
 ... can you see a general pattern?
```

THE FUTURE

The NUDGER system needs to be tested in an ordinary classroom situation. We will be very interested to see how much use children make of a system such as ours, which children are not *compelled* to use in any way. We would also like to continue the development of the NOLOG system: our long-term goal would be a system which supported exploratory programming in NOLOG.

Implementational details have not been discussed in this paper. However, Smalltalk-80 is a somewhat unusual language, and one important research area in which the authors are actively involved is an investigation into how such a language might be exploited for intelligent tutoring systems, and artificial intelligence generally.

ACKNOWLEDGEMENT

This work was commenced while the first author was in receipt of a UK Science and Engineering Research Council Studentship.

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FOCUS ON THE FUTURE: MEETING EDUCATION'S INFORMATION NEEDS THROUGH INSTRUCTIONAL TECHNOLOGY (THE 1990'S AND BEYOND)

LAWRENCE A. WIGET*

ABSTRACT

Existing and emerging instructional technology in the form of satellite delivery systems, on-line databases and networks, compact-disc databases and video-disc technology will enable students and staff of the Anchorage School District in Anchorage, Alaska to access information for instructional needs quickly and efficiently in the 1990's and beyond. However, several challenges exist before successful implementation of these systems will be realized within the District. These challenges include the provision of funding to purchase the technology, resources for training staff and students in the use of the technology, and acceptance of a transitional period in which instructional technology usage may be modified, abandoned, or replaced based both on the effectiveness of the existing technology in meeting instructional needs and in the development of newer technologies.

INTRODUCTION

Alaska is a sparsely populated state, geographically isolated from the rest of the United States. Anchorage, the largest city in the state, has a population of slightly over 220,000 and is approximately 1,500 miles from Seattle, the nearest major U.S. city. The Anchorage School District, with a student population of over 40,000, is ranked in the top one hundred school systems in the United States in terms of student population.

Although geographically isolated, satellite and microwave communication systems provide the state with instantaneous access to information and entertainment from around the nation and around the world. These same systems also provide the Anchorage School District with access to information and resources to meet the instructional needs of its students through audio and video teleconferencing, on-line networking and on-line searching of educational databases, and telefaxing of printed documents. Emerging instructional technologies, including compact-disc (cd) databases and video-disc technology are also being implemented and utilized in the District's libraries, as well as computer labs and take-home computer pilot programs.

The Anchorage School District is in a unique position in comparison to other urban school districts in the United States. Because of its geographic isolation, it is more cognizant of, if not more dependent upon, the use of existing and emerging instructional technologies than districts of comparable size to provide access to information and instructional resources to students and staff.

FOCUS ON THE FUTURE: THE 1990'S AND BEYOND

Existing and emerging instructional technologies which show promise for greater development and implementation in the 1990's and beyond include, but are not limited to : instructional television; audio and video conferencing; on-line networking; on-line searching of educational databases; compact disc databases; video disc technology; computer labs; and, take-home computer programs. The foundation for the use of these technologies is currently being established within the District.

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Instructional Television (ITV) programming is currently limited to four hours per day each day school is in session on the District's cable channel and two hours per day on the local Public Broadcasting Station. For several years prior to 1986, the District cablecast eight hours of programming each weekday, twelve months per year, as part of the State's LearnAlaska Network. LearnAlaska's demise in 1986 was in large part due to funding problems which were caused by a substantial decrease worldwide in the price of oil, on which the state of Alaska's government agencies relied heavily for funding. Lessons learned, however, from the LearnAlaska era, will serve as a basis for future development of the District's ITV resources both now and in the 1990's, with the ever growing presence and popularity of distance education serving as a potential means of meeting specific instructional needs. Videotext applications may also become a reality for the District. However, institutions which are currently implementing videotext are utilizing more than the one channel presently available to the District from its local cable television company.

Audio conferencing, also a one-time heavily sponsored LearnAlaska activity, is a popular means of communicating for schools, organizations and other government and social agencies around the state. (The geographical vastness and remoteness of the state make it difficult for people to meet. The state's capital, Juneau, is cut off from the rest of the state by a glacier and is accessible only by water or air.) One popular audio conferencing activity in which Anchorage students participate is called "Battle of the Books," a competitive event held each year with participating schools from around the state. Students from one school compete with students from another by answering questions about preselected books. The District also maintains its own audio bridge which is utilized for administrative purposes. Audio conferencing serves and will continue to serve as an economical and efficient means of meeting informational needs.

Video conferencing is currently used by the District. National conferences are downlinked, such as those sponsored by NASA, and the "Information Power" conference sponsored by the American Library Association, as well as statewide student oriented conferences sponsored by the Alaska Department of Education. Video conferences by Alaskan State Senator, Ted Stevens, with students from selected schools around the state are also carried. The anticipated near-future purchase of a new satellite dish will enable the District to expand the number of satellites it can access and thus expand the choices of conferences available for both student, staff, and community use. The conferences are one-way video and two-way audio in nature. The 1990's holds the potential for two-way video.

On-line networking of schools through the student management and information system is currently being accomplished through the data processing department. All secondary schools in the District are connected to the system, as well as a number of elementary schools. Electronic mail, a much-used component of the system, was extended to the thirteen secondary school librarians this past fall for their use. Preliminary success by them has resulted in a demand of the service by the fifty-four elementary librarians. The early 1990's should see the system in all schools.

On-line networking with educational organizations and **on-line searching of educational databases** through AlaskaNet is common practice and expected to grow. The District's Library Resources department participates in interlibrary loan and on-line cataloging of library holdings through the Western Library Network (WLN), a bibliographic utility composed of member libraries located primarily in the Pacific Northwestern United States. The department is also experimenting with ordering books via computer with one of its primary vendors, Baker and Taylor. Dialog searches of databases such as ERIC are commonplace both at the administrative and school building level. Dial-up access to the municipal library system database is also feasible. In addition, several schools have or are in the process of linking up with schools overseas. Networking on a state, regional and national level, along with on-line searching of educational databases will expand in the 1990's.

Compact-disc (cd) databases such as *Readers' Guide, Grolier's Electronic Encyclopedia, Books in Print Plus* , and *Microsoft Bookshelf* have been placed in the Library Resources department and will soon find themselves in the schools, along with a growing list of available resources on compact disc. *LaserCat,* a cd product of WLN, which contains the holdings of the Anchorage School District, the Municipality of Anchorage, the University of Alaska, and the 294 other contributing members of WLN, has been placed in each of the secondary school libraries in the District and several elementary libraries. LaserCat or *LaserPac,* a WLN cd product containing the library holdings of only the District, are projected to be placed in all school libraries within the next several years. Networking of cd's, which is still in its infancy, is also scheduled to be part of library and administrative access to information. Cd's, in both the current read-only format and the projected read and write format, may emerge as a primary information storage and access medium in the 1990's.

Video-disc technology is an emerging technology. In early 1989, videodisc players were placed in nine elementary schools and three junior high schools on an exploratory basis. The videodisc placed in eight of the schools contained math lessons for use in remedial instruction. A ninth school received a player and videodisc containing science lessons. Placing videodisc players in all schools was under consideration in early 1989 and potential software applications were being extended to include information resources such as *The History of the 20th Century, The National Galley of Art, and The National Air & Space Museum Archival Discs.* Informational and instructional videodiscs will be commonplace in the Anchorage schools of the 1990's.

Computer labs utilizing commercial education software are being explored for possible implementation throughout the District. A computer lab, utilizing WYCAT math software and consisting of thirty-two Apple //e terminals and thirty-two IBM terminals networked through a fileserver, has been placed in a junior high school. In one elementary school, Education System Corporation's reading, math, and language arts software is being utilized in a program which has a **take-home computer** component. The lab, consisting of thirty workstations, employs twenty-five IBM Model 25's with Hitachi cd players and an IBM PS/2 Model 70 fileserver. Forty-four students also have an IBM Model 25 at home, along with a cd player, and the same cd software they use at school. In this unique program, when students have completed their work on the lab's computer, they take home with them a 3 1/2" floppy disc marking their progress in the instructional process. At home, they continue where they left off at school. The loop is completed when they return to school and insert the floppy disc once again into the lab's computer. Currently, the labs are being utilized for remediation purposes, but the potential exists for incorporation into the regular instructional process.

Under the leadership of William Coats, superintendent of schools, and the coordination of Norm Holthouse, executive director, Management Information Systems, a **take-home computer program** was instituted at seven Chapter One elementary schools and the migrant education program during the 1988-89 school year. Using Prescription Learning math and reading software and Apple //e computers 170 students participated in the program, which allowed them to keep the computers for an entire year. (Prescription Learning, utilizing an MS dos fileserver networked to Apple //e's, also provided software for a twenty station computer lab at one elementary school.) Using the existing sites, the take-home computer program's future potential is being evaluated by the District. Emerging technological and software developments, however, appear to offer the promise of an expanded take-home program in the 1990's.

Telefaxing of printed documents is currently limited to administrative functions. Two machines service the entire District. This coming year's budget includes additional hardware requests, including one for the Library Resources department for its use in ordering materials and in interlibrary loan. The frequency of the use of telefax machines is expected to increase within the District during the next few years and in the ensuing decade, and will more than likely be one of a series of functions available through office or student-use computers.

THE CHALLENGES

The successful implementation and utilization of the existing and emerging instructional technology identified above to meet the information and instructional needs of the Anchorage School District in the 1990's and beyond rests in the District's ability to meet several challenges. These challenges include: funding; resources for training staff and students; and the acceptance of a transitional period.

Funding for technology and its related software is essential. For example, videodisc players and cd players, which exist in only small numbers in the District at the present time, currently cost between $550 - $650 per unit, not including associated computers and video monitors, and stand to become as prevalent in the 1990's as film projectors were in the 1970's and 1980's. There are sixty-eight elementary and secondary schools in the District. Each will require multiple units. In addition, software costs are not necessarily a one-time item. Cd's must be updated on an annual or interim basis as information on them becomes obsolete or out-of-date. Computer networks charge fees for access. A shift in thinking must occur and a realization made that "information costs money."

The new technologies will require **resources for training of staff and students** in both its operation and use. For example, in January, 1989, a trainer was made available to the District courtesy of the Follett Software Company, to train secondary librarians in the use of the new computer-based circulation system which was being implemented into their school libraries. Released time for librarians was provided later in the month by secondary education so that librarians could be trained in the use of the WLN LaserCat system which was also being placed in their libraries. Additional training for students, other staff members and substitute librarians was also being considered.

New technology requires that training be provided in its use and application for successful implementation to occur. The 1990's will see even a greater need for the District to consider training needs as part of its implementation procedures.

It has been noted that the United States, in fact the world, has entered into a new technological age which is impacting not only how we work, but how we entertain ourselves, and how we learn. Like other technological ages before it, the **transitional period** will take a number of years and more than likely will result in the modification, abandonment or replacement of currently emerging technologies based on the effectiveness of the technology in meeting instructional needs and in the development of newer technologies. Flexibility and exploration of the educational uses of technology based upon sound educational principles will be the guidelines for the 1990's. Implementing technology is a dynamic not static process. No single technology will resolve every educational challenge , nor will today's solutions necessarily meet tomorrows needs.

CONCLUSION

Meeting the information and instructional needs of the students and staff of the Anchorage School District in the 1990's and beyond has its foundation in the existing and emerging enabling technologies currently in place or being explored by the District. As the District focuses on the future, challenges do remain to be overcome for these technologies to be successfully implemented and for a base to be established for the implementation of even newer, yet unknown technologies. However, the unique geographic isolation of Alaska from the rest of the United States and the vastness of the state itself, has made the District aware of not only the demand for new instructional technologies to meet its information needs, but also the potential. Thus, the Anchorage School District's *Focus on the Future : Meeting Education's Infomration Needs through Instructional Technology (the 1990's and Beyond*), is based on need as well as desire.

AN INTEGRATED LEARNING CENTRE

I.R. Gomersall and B.T. Lowe *

ABSTRACT

The Bradford Grammar School Information Technology Centre was completed in the summer of 1988. Housed in a purpose built centre, it comprises a modern library, incorporating a computer-based catalogue system, along with a full range of equipment for information access and retrieval.

The Centre operates on an open access basis, with a minimum of timetabled lessons. Facilities include CD-ROM, access to on-line databases (and other information sources), and satellite receiver equipment. Video cassettes, audio cassettes and computer software, along with books, are included in the library lending system, and access is provided to software associated with all the main areas of I.T. (word-processing, spreadsheets, databases, desktop publishing, accounting systems, etc.). Equipment is generally standardised about MS-DOS machines.

Courses in I.T. have made full use of existing good quality materials for Computer Aided Instruction, and a large amount of experience has been built up over a relatively short period of time.

INTRODUCTION

Just over two years ago our school decided to build a Library and Information Technology Centre. This building was completed in September 1988, and has been in use since then. Although the intitial design concept has proved highly satisfactory, our view of the role of the Centre in the school's activities is evolving quickly as a result of experience, and it is one of the purposes of this paper to outline some of these changes.

THE SCHOOL

Bradford Grammar School is a selective independent school in the north of England. It has 1000 students, mainly boys, in the age range 11-18, and a small number of girls in the age range 16-18.

***Bradford Grammar School, Bradford BD9 4JP, England.**

PHILOSOPHY

Initially the centre was designed with two purposes in mind.

1) To provide an opportunity for students to learn about methods of obtaining information.
This was merely a recognition of the fact that Information Technology offers a vastly expanded version of the traditional library. This has long been recognised by librarians, but has been scarcely noticed in schools in the U.K., which have traditionally had relatively poor library provision in any case.
2) To provide an opportunity for students to learn about and gain facility in the major areas of Information Technology.

During the design phase we also had a third purpose at the back of our minds, which was to make it easier to use Information Technology across the curriculum. Although this use was not articulated very clearly at the time, the decision was made that the Centre would be timetabled as little as possible and would operate on an open access basis. Clearly there is a potential conflict between a desire to use a facility for teaching purposes (which must be timetabled) and a desire to offer open access. The growth in the use of I.T. across the curriculum has been rapid and this conflict is already causing problems.

BUILDINGS

The building consists of two floors. The upper floor houses the traditional library, which is large and spacious, along with a library office and a soundproofed teaching room. This room, which is available on an open access basis, makes it possible for a teacher to talk to a class without disturbing other library users.

The ground floor consists of two computer laboratories, a video room, a technician's room, staff facilities, a careers facility and three smaller rooms which can be used for seminars and teaching in small groups. Immediately inside the entrance is a control desk, which acts both as the checkout for anything that is borrowed from the building (books, software, videos etc.), and also as a security barrier. The whole buiding is within this security corden, and all moveable items are magnetically tagged.

EQUIPMENT

A computer-based library catalogue contains information on all information sources in the building. Currently three terminals are provided in the main library, one in the library office and one at the checkout desk. Longer term it is envisaged that terminals will be provided on a decentralised basis throughout the school, offering easy access to this information to anyone in the school buildings.

All new computing equipment purchased for the computer laboratories (and indeed elsewhere in the school) is standardised about MS-DOS. One of the computer laboratories contains 31 MS-DOS machines, a laser printer, a scanner and a CD-ROM driver. Software currently available covers most of the main areas of I.T. and is mainly of a generic nature. Very little of the software produced specifically for the educational market is used in this laboratory, partly because most of it is not available on MS-DOS in the U.K. The second computer laboratory currently houses the school's old Acorn "BBC" machines, and is used predominantly for Computer Assisted Learning on an open access basis. (The BBC machines have been the educational standard in the U.K. for some years, and most of the available educational software has been written for them).

The technician's room is provided with both an ordinary and a satellite video link, a link to the video room and all appropriate recording equipment.

The careers facility provides, in addition to the usual careers information, access to national databases giving information on such things as entry to higher education. This proves particularly valuable when students are looking for vacancies in universities and polytechnics.

FUTURE DEVELOPMENTS

The use of the building is still predominantly in a learning and training phase. MS-DOS is still not common in educational institutions in the U.K. and a large retraining exercise has been required, both for teachers and students. Three strands of development beyond this are, however, emerging.

1. I.T. as an enabling technology:
This is the area that is currently developing most rapidly, probably because good quality software exists in profusion. Word-processing is relatively well established, desktop publishing is proving very popular in many parts of the curriculum and ideas are emerging daily for the use of spreadsheets, databases etc. In simple terms, as a means of manipulating information the pencil and paper is slowly being ousted from pole position.

2. Access to information sources:
This is developing rather more slowly than anticipated. Although the technologies are well established in many libraries, the framework within which this can operate effectively within a school has yet to be established. The two key conditions appear to be a reasonable level of computer literacy among teaching staff and high quality information on the availability of materials within the school.

3. Computer Assisted Instruction:
This area has developed rather more rapidly than expected, although in ways that were not anticipated. The BBC machines had been used for some time for this kind of work, although the amount of good quality software available was very limited. Such good materials as did exist fell into such categories as simulations, data analysis and "dynamic blackboard", rather than direct CAI. Many of these materials continue to be used across the curriculum,

using the old machines. With the introduction of MS-DOS it has become possible to make use of existing good quality CAI packages to teach topics in IT itself. This has proved remarkably successful, despite our initial scepticism. Our initial (very tentative) conclusions are

-that the technology currently available to schools is good for teaching skills, but not higher level processes, and

-that it is necessary to set tests at frequent intervals to get the best possible results. Such tests are often best answered using the computer. It also helps if they are set with no time limit, so that students can have time to find out the answers if they don't know them. In this way the tests act more like projects, but students seem to have a higher motivation to get full marks.

CONCLUSIONS

The introduction of a centralised Library/I.T. facility at Bradford Grammar School has already proved to be a great success when measured in terms of use. On average 1000 people pass through the security barrier every day (the school has 1000 students). The use of the facility has developed in a number of unexpected ways, and some interesting progress has been made in the area of Computer Aided Instruction.

Standardising on MS-DOS has led to many benefits, especially in terms of equipment compatibility and quality of software, although this has led to short term training problems.

Finally it must be said that centralisation has its limits. Indeed we see the next phase of development as including a significant degree of decentralisation, including more microcomputers in classrooms and laboratories and catalogue terminals throughout the school.

CONCEPTUAL MAPPING: A TRADE-OFF BETWEEN METAPHORES FROM THE PAST AND COGNITIVE COMPLEXITY IN HYPERMEDIA SYSTEMS

P A M Kommers

ABSTRACT

The DELTA program "Developing European Learning through Technological Advance" has been taken up by three actors in the field of education:

- - Hard- and Software Companies
- - Publishing Companies
- - Research Institutes in Human Cognition and User Interfaces.

The current paper session presents the overall architecture for media-centered learning stations. It can act as a case for applying and testing the LSRM "Learning System Reference Model". This paper reports about the design and technical preparation of a Generic CD-Interactive. This means that the CD-I can be prepaired to be embedded in a variety of courseware packages.
Besides that, the CD-I should be stand-alone, supporting "exploratory learning" and encouraging "learning by discovery".

The first stage of design comprises the definition of the metaphoric contract form the system to the student. The learner is confronted with a schematic representation of the toplevel relations in a knowledge domain. In the background graph computation helps to prompt the centrality of the concepts.
Secondly the learning function of the system was divided in "Learning by Entertainment" and "Learning by Instructional Strategies". Both approaches are not intended to oppose but seem to be complementary and are both necessary for real life learning.
Thirdly, the resource variety was created by the cooperation with Elseviers Publishers, delivering the text and pictures of the Medical Encyclopedia.

The technical side of the project has been approached as an enterprise for knowledge engineering. This will be illustrated in the way teachers and domain experts are elicited to define relations and rules between

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concepts. HYPERTEXT procedures have been used for the final interface to the student.
Rule editors, and conceptual networking have been used to reinforce ideas of local teachers, which should be assimilated in the final dialog to the students.

The paper session will be completed with a demonstration of the user interface for educational CD-I.
Philips International and R.R. Donnelley made a joint venture in OptImage, in order to set up dedicated tool environments for CD-I authoring. The paper will outline the conceptual workbench for prepairing HYPERTEXT relations, and the cognitive space for students to retain the encapsulated knowledge.

GC EDUNET: BUILDING AN ELECTRONIC COMMUNITY

E.M. Wolpert*, F.A. Lowney*, J. Wolfgang*

ABSTRACT

An electronic information system that networks some 200+ public schools and the faculty of the School of Education at Georgia College is being implemented. High speed modems, telecommunications software, and telephone service have been provided without cost to participating schools. Comparing the design criteria with actual operations to assess the status of the project, it was concluded that the system was very near the point where empirical study would be fruitful. Additional experience with the system, additional end-user training, additional hardware, updated software and additional personnel were identified as those ingredients necessary to effective empirical study.

INTRODUCTION

One of the major problems in the field of education today is the isolation of teachers.

In order to access, maintain and extend their knowledge base, professionals in any field must have ample opportunities to interact with those who are dealing with the same situations that they are. They need to be able to compare notes, share ideas, strategies and materials, and support one another in a wide variety of ways. This is no less true for educators than any other group of professionals.

In contrast to other professionals, teachers are unlikely to attend conferences and professional meetings at which events they could interact with their colleagues, sharing ideas, materials, beliefs, problems and successes. Most interaction, if it is to occur at all, takes place on a limited, random, unplanned, catch-as-catch-can basis. This unfortunate situation is attributable to the fact that there is rarely funding either for teachers to travel to these events or for substitute teachers to cover their classes. Additionally, there has not heretofore been a tradition for this type of inservice professional development. It is the experience of the authors that teachers do indeed want to communicate with one another but are often frustrated in their attempts to do so.

Exacerbating this phenomenon is the fact that in many parts of the country, schools are isolated geographically; schools are located where the children are, and the children are sometimes in isolated rural areas well separated from the main population areas. Such is surely the case in middle Georgia which is the primary service area for Georgia College.

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In 1987, Georgia College was awarded a continuous grant from special initiative funds by the Georgia State legislature for the purpose of improving teacher education in the middle Georgia area. This led to the development of the Regional Teacher Education Center at Georgia College (RTEC at GC). One of the major projects funded by RTEC at GC was the initiation of an electronic information service called GC EduNET: The Georgia College Educator's Network. This service was designed to reduce the isolation of middle Georgia's teachers (and other educators) by providing the capability for electronic conferencing, electronic mail, file sharing, on-line database searching, and other communicative activities. The service is free to all schools in Georgia College's primary service area, and available at low cost to others in the state. Attempting to alleviate teacher isolation with an innovative and comprehensive technological intervention strategy like this is, to the best of the authors' knowledge, a unique effort.

THE TECHNOLOGY

GC EduNET is an information system that works in conjunction with an AppleShare network. The primary file server is a Macintosh II with a 40 Mb internal hard disk. Additional hard disks and file servers bring the total memorial capacity to well beyond 100 Mb. The network itself is composed of a number of terminals on the desks of faculty (either an Apple IIgs, an Apple Macintosh or an MS DOS clone) in the School of Education and several terminals (Apple IIe) serving as telecommunications ports. GC EduNET will support multiple, simultaneous access to selected portions of its information base through these telecommunications ports. It is through these ports that educators in our service area and beyond access the many features of GC EduNET. GC EduNET is unique in that it is a local area network which may be accessed remotely.

Both internal and external access to GC EduNET features is managed by conventional AppleShare protocols plus software developed by Russ Systems of Santa Cruz, California. The Russ Systems' software extends the AppleShare system through the use of a simple, but versatile, scripting language. Scripts generated by this very easy to learn language control the collection, organization and presentation of information throughout the network. Thus, electronic mail, conferencing, searchable data bases, surveys, testing, tutoring, and a host of other important features are easily implemented by faculty who have no training in computer programming. Access to view and/or modify these information "presentations" is fully configurable regardless of whether that access is internal or external in origin.

Participating schools were provided with telecommunications software and a 2400 baud internal modem for an Apple IIe or IIgs (the commonest computer in area schools). The only condition for the equipment was that the unit be placed in such a way as to maximize access by classroom teachers. Additionally, several WATS lines were provided that were configured so that they would "roll-over" to the next available line when busy.

Thus, school personnel were afforded convenient, low-cost or no-cost access to an information service that enables them to confer with one another individually or in groups as well as to acquire and share a broad range of education-oriented information.

RESULTS

GC EduNET went "on-line" on October 1, 1988. Between that time and January 1, there have been 1,935 calls from remote sites totaling 291 hours of connect time. There are 212 members authorized for remote access representing a broad cross section of educators throughout the State of Georgia.

An analysis of the activity and public comments of remote callers and the evaluations tendered by faculty and staff involved in the establishment and maintenance of the information base of GC EduNET revealed that the nominal potential of the system had not yet been reached but was clearly within grasp. Reaching this point is considered critical to launching any empirical studies as to the effect of this information service on its various constituencies. To do otherwise would be tantamount to knocking down a straw man; not a fair test of the proposition that professional isolation among classroom teachers and other educators could be alleviated through the use of telecommunications technology.

It was further concluded that several enhancements must be made before meaningful empirical research can be conducted. First, the faculty and staff developing and refining the collection, organization, and presentation of information on GC EduNET need to become more familiar with the system and the scripting language which undergirds it. Second, end-users of the system, especially the remote (public school) users, need to be given additional training, particularly in advanced techniques. Third, additional hardware is needed. Specifically, the problem of entering vast amounts of textual data (labor intensive) can be resolved through the use of a flat bed scanner and optical character recognition software. Fourth, improvements and additional features should be added to the software. The developers of the software are sensitive to this issue and are, in fact, responding to this need. Fifth, and most importantly, additional personnel with responsibilities for cultivating various portions of the information base are needed. These additional personnel must be knowledgeable in the areas they cultivate and must be sensitive to the constituencies which make use of those areas of the information base.

When these conditions are met, perhaps as early as the Fall of 1989, serious empirical work may be attempted.

INFORMATION ON THE DELTA PROGRAMME. (DEVELOPMENT OF EUROPEAN LEARNING THROUGH TECHNOLOGICAL ADVANCE)

Michael W. Rogers*

ABSTRACT

DELTA is a Europe-wide initiative in the application of new technology (information and telecommunications) to learning. It aims to develop emerging technologies so that they can be used in the training and re-training context, but without the constraints of more traditional delivery vehicles. Distance and Open Learning are focussed upon in the initial phase of developments, which will last for 2 years and support about 40M US$ work of work in some 25 projects. A first generation Portable Educational Tool Environment (PETE) will be used in the second half, and the European Learning Technology Association (ELTA) will assure information flow across and out of the projects, while also filtering inputs.

THE DELTA PROGRAMME

DELTA takes a systems view of European learning, and proposes an exploratory action for providing Europe with learning equipment and systems for the future. It is to be a collaborative Research and Development programme of the European Community - one of three designed to help the application of information technology and of telecommunications (IT&T) to key areas of economic and social importance. It is aimed at IT&T industry, broadcasters, media publishers and educational technologists.

The rapid rate of change of technology implies the need for continuous training and retraining. **The most economical way to meet this challenge is to use the same technologies of information and telecommunication which are re-shaping our whole environment.**

A DELTA Exploratory Phase, to which the Council agreed on the 29th of June 1988 (O.J.L206, 29.7.88), will last for a maximum of 24 months, with a contribution of 20 million ECU from the Community Budget. The basis of the projects will be cost sharing between the participants and the Community. The contribution of the participants will be not less than 50% of the total cost of the project. For universities and research institutes, funding may be 100% of the additional costs involved in participation. Proposals should reflect industrial, media and learning interests. Commercial interests have taken up the challenge, and lead in putting forward proposals.

The research is pre-competitive; that is, it must relate to that stage of cooperation between the various partners at which they can work together without affecting their will or their ability to compete in the market-place. The work in the preparatory phase must have value in its own right for the industry at large, and the action must also consider how to capitalise on the output of this exploration.

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The research is also incremental. This means that DELTA is based on other developments already in the pipeline; for example the emerging results of ESPRIT and RACE. **DELTA will support the research and development required to enable these emerging technologies to be utilised for the benefit of learning.** The devices and techniques to be addressed include: higher functionality in hardware design, including image processing, larger and cheaper storage, with relevant techniques of data organisation, Direct Broadcasting by Satellite, the Integrated Services Digital network, the use of artificial intelligence, access by near-natural language and in the more distant future switched broad-band communications. In the initial action, the emphasis will be on building synergy between learning requirements and emerging technology, while creating the European critical mass dimension by the development of an intercept strategy between these technologies, learning interests and industry.

The total DELTA concept distinguishes three time horizons which DELTA will traverse, each bringing its contribution of identifiable technological advances. Appendix 1 sets out these horizons.

The programme is currently divided into five lines of action which are listed in Appendix 2 on which the 1988 call for proposals (see below) was based on tasks related to these headings.

It is to be emphasised that DELTA is a programme for research and development in **learning technology**; it is **not intended to support the writing of courseware** - which is part of COMETT's brief. Intending participant would be well advised to take note of the content of the work programme as it stands at present, since the call for proposals will relate tot he headings and subheadings of the programme of work as it is approved by the DELTA Committee. The need for a commercial participant in each proposal is particularly to be noted, and, of course, for partners in other Community countries. Ideally, organisations wishing to participate in any phase of DELTA should already be clearing their lines with possible partners in advance of the call for proposals. To this end, the **Eurocontact** facility is being made operational for DELTA, as well as **EUROKOM**, the European E-mail system.

During 1988, interest in DELTA has grown rapidly to 4,500 organisations. The DELTA call for proposals was 10 times oversubscribed and the list of projects will be presented later. **There is also a growing database - over 1,000 researchers and their interests in the DELTA domain,** who receive in return a full set of responses and an index. The details of these returns are soon to be available on-line as part of the Eurocontact database. This should be useful both in its own right and as an eventual help to potential DELTA participants seeking partners. This is open to all potential contributors irrespective of whether they are contractors.

Even if one is not able to participate in a project, DELTA supports the European Learning Technology Association, which is open to all interested parties, and acts as a forum for discussion and harmonisation of conventions, standards and project reviews throughout the DELTA exploratory action.

For further information please contact the **DELTA Central Office - DGXIII-F, TREV 00/1,** Commission of the European Communities, 200 Rue de la Loi, B 1049 BRUSSELS. Telephone: +32.2.236.34.16, Telefax: +32.2.236.23.92.

Appendix 1

Time Horizons

The three time horizons which DELTA aims to traverse are:

Exploratory Phase: 1989-1890

Enhancement of Current Technology
Planning the synergy and standards strategy for success.

Level II: 1990-1995

ISDN (Integrated Services Digital Network)
More powerful PC's (32/64 bit,>100 Mbyte)
Image processing
Direct Broadcasting by Satellite
Artificial Intelligence components.

Level III: 1995-2000

Integrated Broadband Communications
Characteristics of Intelligence in Systems
Natural Language / Voice interfaces.

Appendix 2

Action Lines

Action Line 1 is a concertation on system requirements via a Reference Model, which will also serve the planning and management of the programme. The tasks include evolution and maintenance of the model, and the creation of a grouping that enables the actors to articulate technical and related factors.

Action Line 2 provides for the collaborative research and development of the equipment and systems required - both hardware and software. The items covered under this line of action include:

1. **Learner Environment - Home, Office, Specialised**
    Portable Educational Tool Environment (PETE)
    Training Server
    Learner Expert System
    Personal Electronic Library
    Electronic Notebook
2. **Authoring Facility**
    Software Workbench
3. **Production Environment**
    Multimedia Integration
4. **Tutoring and Monitoring**
    Tutoring Facility
    Intelligent monitoring of performance
5. **Information Resource Management**
    On-Line European Learning Resource Directory
    Intelligent Information Accessing

Action Line 3 comprises testing and validation, including communications; an important component is "SOFT" - Satellite Open Facility for Testing, aimed at the trial use of satellites for learning. It includes:

1. Video-audio conferencing
2. Information and programme exchange system
3. Adaptation to ISDN
4. SOFT operational plan
5. Design and specification of a Satellite Educational Channel
6. Controlled experimentation via SOFT

Action Line 4 has the objective of "interoperability", i.e. support for the participation of the learning interest in the ongoing work on standards of all sorts:

1. Identification of standards relevant to learning
2. Organisational support for learning standards

Action Line 5 seeks the creation of favourable conditions for learning:

1. Fiscal treatment
2. Regulatory conditions
3. Telecommunications policy
4. Copyright and authors policy

"POCO" COURSEWARE DESIGN METHODOLOGY

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INTRODUCTION

POCO is a project for the development of educational courseware.
It is a "project" in the true sense of the word: it has a clearly marked beginning, and it has a clearly defined end-date, at which a number of objectives will have to have been realised. The span of time in between is divided up into two cycles, and the cycles again into phases in which intermediate goals have to be reached, to allow for optimal control of the courseware development.
POCO started in September 1987 with the first cycle, and will finish in September 1991. The first cycle has ended in the beginning of 1989. By that time 18 courseware products were completed. During the second cycle, which starts in 1989 and lasts until the end of the project period, another 35-40 products will have to be realised. The target is, by 1992, to have created a sufficient quantity of educational software to support 5% of the lessons in the schools' lesson schedules in secondary education, and 1% in primary education. The POCO budget is Dfl. 26 million.

BACKGROUND

POCO originated against the background of INSP, the Dutch national plan to stimulate the introduction of information technology in education and in society. POCO's target group consists of the schools for primary, general secondary, and vocational education. They have been consulted in establishing priorities for the first 18 products, along with national, governmental and general institutes that work for education. There is an ongoing consultation with the target group during the production process.

COURSEWARE AND OTHER PRODUCTS

In the first cycle products will be developed for the following subjects:

- Primary education:
  - Elementary reading
  - Applied arithmetic
- General secondary education:
  - Dutch: Spelling
  - French: Integrated Language Environment
  - English: Integrated Language Environment
  - English: Thematic subjects for communicative skills
  - Geography: Educational database with cartographical features
  - Mathematics: Functions and Graphs
  - Mathematics: Equations
  - Physics: Measurement Tools
- Vocational education;
- Economic-Administrative sector:
  - Improving keyboard skills
  - Word Processing at a conceptual level
  - Administration and Book-keeping at a conceptual level
- Technical sector:
  - Toolbox for measurements in Laboratory activities
  - Reading and interpreting technical drawings
  - Practising and demonstrating applied mechanics

Service and Health education:
Drawing techniques for Fashion Design
Simulation of a Hospital Information System

"Courseware", in POCO, means "software plus written materials", such as coursebooks, textbooks, pupil hand-outs, teacher hand-outs and of course software documentation.
All the software will be developed in conjunction with teaching materials that are commonly used in education in the Netherlands. The development process is carried out in cooperation both with the users of teaching materials, - teachers, in the first place -, and with the providers of teaching materials, - the Dutch educational publishers.

PROJECT MANAGEMENT

The project management for POCO has been assigned to ECC (Educational Computing Consortium), the privatized successor of COI (Center for Education and Information technology), Twente University. The ECC Project Management division is responsible for the overall management. Other ECC divisions, Research & Development (with expertise in specification and design) and Information & Evaluation (field testing and courseware evalution) carry out several phases of the project, on a contract basis, under the management of the POCO-team.
The POCO-team consists of a general project manager, two senior project managers, three project leaders, a small staff for secretarial, administrative and financial affairs and a project support group for non-regular or very specialized activities that require specific expertise.

PARTNERS INVOLVED

At the beginning of each POCO-cycle a list of priorities is established. This is done by consulting schools, and national and governmental institutes in the field of education. The products to be made by POCO are chosen from these lists by the Dutch Minister of Education.
Throughout the project the responsibility for all products lies with the POCO managament team. However, the realisation of products belonging to each phase is carried out either by ECC-divisions or by other subcontractors.
The ECC-divisions Research & Development and Information & Evaluation are executive parties in respectively specification and design, and field testing and evaluation.
For the other phases possible subcontractors may be: software houses and suppliers of data or databases, publishers and their authors, and educational institutes.

SOFTWAREHOUSES

To find suitable sub-contractors an open tender procedure has been set up. Announcements were placed in national dailies and automation weeklies, inviting software houses and database suppliers to respond and sign in for one or more products in the POCO-project. Emphasis was given to standards for specification and design, techniques, library routines and programming languages to be used, and standards for user-interface, evaluation and documentation. Parties had to be willing to work on a fixed price- and fixed-date basis. The response was enormous, some 155 softwarehouses signed in.
After an initial selection two or three software houses were asked to suggest a plan of action and to make an offer on the basis of the functional specifications. The final selection of a softwarehouse for a particular product was based not only on financial criteria, but also the quality of the plan of action, personell capacity and general experience.

EDUCATIONAL PUBLISHERS

Cooperation with the Dutch educational publishers has been established in a manner, similar to the tender process for software sub-contractors. A prospectus was sent to all educational prublishers who were then asked to sign in on products they would eventually want to market in conjunction with their coursebooks or textbooks. Here, too, the POCO management used a set of criteria to select partners for cooperation. One of the most important criteria was the market segment each publisher holds with their publications in a particular subject area. Since the size of this market share forms an immediate indication for the size of the target group, it bears relevance towards the possibility to ensure "frequent use" for the POCO-software. Willingness to contribute financially and by having authors cooperate were also important criteria.

Another way to produce courseware that fits in with everyday teaching practice, is to ensure evaluation and validation by teachers and field experts in every phase.

PHASES IN THE POCO-PROJECT

Every cycle in the project starts with a phase for establishing priorities. After this phase the actual production starts. In every production period the following phases recur:

- product description
- technical realisation
- field testing
- adaption
- distribution

Each milestone in each subphase and each end product is considered input for the next phase or subphase. The Quality Pssurance Plan describes the quality demands which every product has to answer.

QUALITY ASSURANCE

The way quality will be assured in POCO has been laid down in a written document, the POCO Quality Assurance Plan. The POCO-QA-plan presents the quality assurance for POCO in general. The QA per product is laid down in an individual mini QA-plan.

DESIGN METHODS AND TECHNIQUES

The method of specification in the product description phase is based on the Yourdon-methodology. Context diagrams, dataflow diagrams, entity relation diagrams, state transition diagrams and screen-sequences describe the context of the courseware product to be built, the functionality, the relations between data and the possible sequences of screens.

One important activitiy in the product description phase is prototyping. The prototype is not part of the functional specifications, but the process of setting up the prototype is meant to confront potential users with key design-decisions on crucial points in the courseware-product. Generally Hypercard is used.

Besides a functional design in design techniques, the specifications consist of a verbal description of the functionality. In practice the verbal description is the part that teachers and authors find pleasant to refer to initially, when they have not yet come to feel at ease with the design techniques. Softwarehouses tend to work straight from the drawings. In communication with them, however, the verbal description is often used to clarify issues.

Based on the specifications the softwarehouses produce a system design that is still mainly functional, but pays some more attention to technical implications of functionality and interactions. This first external design is an important step since it expresses the softwarehouse's understanding of the system as it has been designed within ECC. All further decisions and designs are based on this understanding. In the system design a data dictionary is set up which has to be carefully studied by the authors, since the dictionary will determine the formast within which they have to frame their texts, feed back clues, and data base. Yourdon techniques are used to describe the system.

Yourdon techniques also play an important role in the technical design. This final design is the documentation that will be used for coding, and later as a reference document during maintenance. The technical design completes the inventory of hardware consequenses, in the sense that limitations in the hardware must lead to limitations in the systems. The Dutch educational hardware standard (IBM-compatible MS-DOS machines, type XT-AT) must be adhered to.

IMPLEMENTATION METHODS AND TECHNIQUES

For the realisation of the courseware in POCO no authoring languages are being used. POCO-products are realised in Microsoft C (version 5.1) or Turbo Pascal (version 4.0). However, the use of microsoft C prevails. Pascal was used only in a few cases where existing Pascal programs were used or incorporated into POCO-software. These products will eventually be rebuilt in C.

Programming tools that may be used are also prescribed in the QA-plan. Besides there is an educational software library which holds standard routines for educational courseware. Guidelines for coding and technical design, the use of standard procedures and routines, source lay-out, and source code documentation are part of the QA-plan.

A special user-interface has been designed which is used in all products. There is an empty demonstration version as well as a written specification. Both show the layout of screens, the use of a menu bar in combination with pull down and/or pop-up menus, different windows for various interactive functions, keyboard usage, and the use of peripheral devices.

PRELIMINARY CONCLUSION

So far, in the POCO-project it has proved possible to design courseware with traditional software development techniques, involving teachers and experts in the design teams. Educational technologists served as intermediaries to translate educational demends to information technologists. This enabled the project to work with traditional software houses on a subcontracting basis. It was found that the effort to standardise paid off in that it reduced the need for discussion or exchange of views in the technical phases. Also teachers and authors were able to invest some time in learning to read specifications, because having grasped the principles once they were able to use their experience all along.

During the conference session questions on the details of the design methodology will be answered.

A COMPARISON OF SOVIET AND AMERICAN PUBLIC ATTITUDES ABOUT COMPUTERS: CURRENT FINDINGS AND FUTURE POLICY IMPLICATIONS

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ABSTRACT

During the summer of 1988, a computer opinion survey was circulated to Soviet citizens visiting a USIA exhibit in the Ural mountain city of Magnitogorsk and to American visitors to the Smithsonian Institution in Washington D.C. Responses by country, age and interaction effects of country with age and gender with age showed the most significant differences. This paper describes the various responses and suggests societal reasons for the differing responses.

INTRODUCTION

Computers have played a prominent and highly visible role in American society for the past twenty years, but they are just starting to find their way into Soviet schools, offices and homes. Under the current Soviet five-year plan ending in 1992 (ref 1), the intention is for one million microcomputers to be built. A computer club for teenagers has opened on Arbat Street in Moscow and a social club for all of the citizens of Troisk has at least 15 microcomputers for use in the club. Irkutsk, in Siberia, with a population of 250,000 people has opened a Personal Computer Center with 20 microcomputers and several printers for use by the local citizens. The United States and the Soviet Union have launched an exchange program which will include groups whose interests are sharing information about computers in the schools. As a result of the new emphasis on computer technology in the USSR, the Soviet public is becoming more aware of computers.

METHODOLOGY

During the summer of 1988 the first survey of Soviet public attitudes ever allowed by Soviet officials was presented to visitors at a United States Information Agency (USIA) sponsored exhibit. This exhibit, Information in the Life of the USA, visited nine cities from June 1987 to January 1989. Based on a published questionnaire (ref 2) a pilot form of the 10 question survey was distributed to 200 Soviet citizens in the Siberian city of Irkutsk in June, 1988. The survey instrument, in both English and Russian, included 10 questions answered with a yes or no and two demographic questions about gender and age (child, youth or adult). The responses to all questions were registered by folding a tab over the response, thereby reducing the need for pencils and other response mechanisms. In the pilot study the Soviet respondents were questioned as they exited the exhibit but

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while they were still within the exhibit building. Early in July, 1988, 200 American visitors to the National Museum of American History of the Smithsonian Institution were surveyed as part of the pilot study.

Based on the results of the pilot study, the Russian version of the questionnaire was altered slightly in order to make the demographic categories more clear. Both the English and Russian versions of the survey were presented as shown in Table 1, and in the reverse sequence to assess potential order effects. In addition, the survey was administered before and after the Soviet respondents visited the USIA exhibit. On any day when polling was done before and after Soviets had visited the exhibit, polling of those who had visited the exhibit was done first. In July 1988 more than 1000 Soviet visitors to the USIA exhibit in the Soviet city of Magnitogorsk were polled. An equal number of American visitors to the Smithsonian Institution were polled in an area near the entrance to the museum where there was information about an upcoming technology exhibit.

Table 1 Questions from the attitudes about computers survey

1	Computers are always right
2	Computers are more than a tool
3	Computers will make life more complex
4	Someday everyone will use a computer
5	Computers should be developed that understand human language
6	Only experts can use computers
7	Computers are fun to play with
8	Computers are basically good
9	Computers always do as they are told
10	Most people do not need to learn about computers

RESULTS AND DISCUSSION

Multivariate analysis of variance (SAS PROC GLM) revealed reliable differences in the pattern of responses between demographic groups. The overall proportion of "yes" responses are summarized in Table 2 and Table 3. Four of the 31 tested effects were statistically significant beyond the .0005 level: country, age, the interaction of country with age, and the interaction of age with gender. The patterns of responses that are most strongly associated with these effects depend on the combination of responses by individual respondents and are not always apparent in the tables.

The difference in the pattern of attitudes between countries is large, accounting for 15% percent of the variance in responses. The pattern of responses that reflects the attitude difference between Soviets and Americans is dominated by responses to "Only experts can use computers" (q 6). Fewer than 3% of Americans agreed with this statement while 32% of the Soviets agreed with it. In addition, more Soviets than Americans tended to agree that "Computers should be developed that understand human language" (q 5) and that "Computers are always right' (q 1) but to disagree with "Computers will make life more complex" (q 3).

The effect of age, across all other demographic categories, is primarily a difference between the attitudes of children (age<12) and those of youths (ages 12 to 21) and adults. The pattern of responses, accounting for 5% of the variance, that distinguishes children from the other respondents is that children agreed that "Computers are always right" (q 1) and that "Most people do not need to learn about computers" (q 10) while they disagreed that "Someday everyone will use a computer" (q 4). This might be interpreted as an attitude of awe or intimidation.

Table 2. Percentage "yes" response by Country and Age

Percent yes	American			Soviet		
Question	Child	Youth	Adult	Child	Youth	Adult
1	32	15	17	60	32	29
2	84	84	70	62	70	62
3	35	34	27	23	19	19
4	62	73	80	78	82	83
5	82	86	90	91	92	90
6	1	4	2	31	19	39
7	96	93	93	94	93	93
8	96	93	94	90	92	95
9	48	48	58	60	61	59
10	30	18	15	34	23	24
N	99	229	612	129	286	611

Table 3. Percentage "yes" response by Gender and Age

Percent yes	Male			Female		
Question	Child	Youth	Adult	Child	Youth	Adult
1	41	23	22	55	25	22
2	73	78	64	71	74	70
3	31	29	22	26	21	25
4	70	76	84	72	80	79
5	91	88	93	84	91	86
6	16	13	18	19	10	21
7	95	94	93	95	91	93
8	94	92	95	91	94	94
9	50	62	62	60	46	55
10	25	20	19	40	20	20
N	113	178	640	115	237	583

Age interacts with gender such that a combination of responses accounting for 3% of the response variance, shows no gender effect for children, but a significant gender effect for youths and adults. This combination of responses decreases with age for females, and peaks for male youths. The responses are agreement that computers are obedient (q 9), fun (q 7), for experts (q 6) and will make life more complex (q 3), and disagreement that computers should understand human language (q 5) and are basically good (q 8). We might call this a "hacker" attitude pattern.

Age also interacts with country in a complex way. On a combination of responses accounting for 2% of the response variance, Soviet children and youths are most similar to American adults, Soviet adults are most like American youths, and American children are in the middle between the extremes of the two groups. The pattern of responses that characterizes this unexpected grouping of American adults with Soviet children and youths is agreement that "Computers should be developed that understand human language" (q 5) with disagreement that "Computers are basically good" (q 8). Maybe this is the group of respondents who believe that what is wrong with computers now is that they do not understand human language.

CONCLUSIONS

Knowing that the two populations respond differently shows that there is a difference in attitudes about computers in the two countries. These differences can examined from several perspectives. On the one hand, we have two societies that are at different points along the technology continuum. Computer technology is just starting to become available through schools and computers clubs to Soviet citizens, much the same way that computers became available in the United States twenty years ago. Soviet attitudes about computers today are probably similar to American attitudes 20 years ago.

In addition there are tremendous cultural differences between the Soviet and American societies. The Soviet society is a very structured one. Education is very disciplined and directed. Everyone has an early chosen specialty and everyone is trained to be an expert in that specialty. Against this backdrop, it is understandable that Soviets would see computers as the special tool of experts.

Finally, microcomputers are essentially information processing and disseminating devices. Within the context of the closed society that has existed in the Soviet Union for the past 70 years, radical social changes will have to take place for computer technology to proliferate there as it has in the United States. It is possible that changing attitudes about computers will occur quite rapidly in the Soviet Union as technology helps to drive the new age of glastnost.

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ACKNOWLEDGEMENTS

Professor Richard Robin, Slavic Language Department of the George Washington University for translation of the survey.
A.V. Deepak, summer intern for work on the pilot study.
Dr. DeeDee Hilke, National Museum of American History, Smithsonian Institution for help with the research design.
Patty Monte for data entry.

THE STATUS AND FUTURE OF TELECOMMUNICATIONS VIDEO TELECONFERENCING IN ENHANCING EDUCATION AND TRAINING

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ABSTRACT

Both private and government activities are becoming increasingly decentralized, with facilities and personnel spread over large geographic areas. Further, both sectors find an increasing need for degree-oriented academic programs and continuing education to maintain and upgrade the skills of a diverse workforce. Throughout the world, the last ten to twenty years have seen many innovative systems developed to meet these needs. The University of Texas at Arlington (UTA) has been delivering graduate engineering education simultaneously in campus classrooms and via full bandwidth NTSC television to remote industrial sites for nearly nine years.

That experience demonstrates both the potential and deficiencies of existing technologies. Technological solutions are available that make education and training at a distance as effective as in-residence work. The principal obstacle remains, as it has been for many years, transmission costs.

INTRODUCTION

The Dallas-Forth Worth area and its educational needs are a microcosm for many regions of the world. Two large cities are in close proximity, with major industrial complexes surrounding each, and in the intervening area as well. The major complexes span an area more than 100 miles across. A demand exists for remote delivery of masters level programs in electrical, mechanical, aerospace, and computer science engineering throughout this region. A demand also exists for baccalaureate programs, notably in electrical engineering, although that need is only beginning to be met. A few senior-level courses are offered, but principally for graduate credit. A further pervasive need is for a wide variety of continuing education programs in many fields. The capacity limitations of the existing transmission system and the cost of expanding the current network has prevented a significant satisfaction of this need. New technologies offer the potential of greatly increased network capacity.

PROGRAM GROWTH

The rapid expansion of the program is vividly demonstrated in Table I below. From an initial enrollment of 38, remotely located students, the current enrollment now surpasses 1000. Similarly, the initial 14 courses offered has grown to 104 in the current academic year. The courses can now be received at 26 industrial locations in the Dallas-Fort Worth region. All in-plant class rooms, facilities, and all additional costs to the university resulting from the television program, aside from the capital costs of equipping television studios on campus and the cost of operating and maintaining the studios, are paid for

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by the companies whose employees are enrolled. The companies using the service fund the transmission, messenger service, and other incidental costs. All courses are, in general, live transmissions. Prerecorded taped transmissions are only used in unusual circumstances, as when a professor is on travel. Tapes are available, however, to students who have missed classes.

TABLE I

NUMBER OF TELEVISED GRADUATE ENGINEERING COURSES

ACADEMIC YEAR	COURSES OFFERED	ENROLLMENTS
1980-81	14	38
1981-82	29	227
1982-83	32	349
1983-84	55	521
1984-85	78	755
1985-86	84	847
1986-87	86	1121
1987-88	91	1066
1988-89	104	est. › 1100

CURRENT TECHNOLOGY

The courses are offered through the Association for Higher Education of North Texas' (AHE) video television network. It is largely a closed circuit microwave system, although some ITFS channels are also used. Current capacity limits UTA to two simultaneous channels in general, with some time slots in which three simultaneous channels can be originated. UTA will ultimately have a total of seven classrooms capable of originating transmissions, but these will be used for local purposes as well as to support the TAGER network. For example, UTA has an Automation and Robotics Research Institute located 10 miles from the main campus which will be connected to the campus for the origination and reception of courses.

UTA also has commercial communications satellite receive capability and routinely receives nationally broadcast continuing education and conference transmissions. These signals can be distributed throughout the University to classrooms and conference rooms, as well as to the TAGER studios and network.

The television studios/campus classrooms are equipped with modern equipment, such as remotely controlled broadcast-quality plumbicon color cameras, computer-assisted production switchers, and precision remotely controlled camera positioners. Overhead cameras are used to display graphs, books, and handwritten material, while other cameras are directed at the "whiteboards" in the classroom. The classrooms are specifically designed to enhance a "candid classroom" atmosphere for both on-campus and off-campus students. The classrooms are all equipped with several 26" color monitors suspended from the ceiling so that on-campus students can have the same advantages as the off-campus students. A larger auditorium style classroom will shortly be equipped with a high quality video projection system for presentation on a large screen.

Audio talkback via telephone lines is provided so that remote students can be involved in classroom discussions and have immediate interaction with their instructors. Facsimile machines are also used to connect the campus to the distance sites.

All experience suggests that, for graduate lecture courses, there is little measurable difference between the quality of the educational experience at the remote site versus that in the classroom. Further, experience suggests that instructors tend to prepare better for television classes, and the overhead television cameras allow the efficient use of a much wider variety of auxiliary materials. Indeed, in-class students tend to spend a large share of the time following the class on the monitors that are place around the room, instead of looking at the "live" instructor. Therefore, even with current technology, televised courses are not a second-rate form of education, but enhance rather than detract from the educational process.

SIGNIFICANT CURRENT LIMITATIONS

In spite of the positive nature of the above comments, there are significant limitations to further advances. Obviously, low cost data compression systems that could be used to expand the number of channels that can be carried are a major need. Once capital equipment has been procured, the chief operating costs are those for transmission. Current compression systems have severe limitations in spite of costs in the range of $100,000 per unit.

Notable by its absence in the above, is the extensive use of computer-generated graphics and simulations. This is an obvious major enhancement that is just beginning at engineering schools for on-campus students. Clearly, this would be a great enhancement of the off-campus experience as well. In addition to the channel capacity, transmission cost, and data compression issues that are raised, additional capital expenditures are necessary and network compatibility of the various computer equipment becomes an issue.

Some national and statewide systems are already in place based on satellite communications. While the technology is available, the diversity of local requirements, the differing approaches to instruction (e.g., live vs. tutored video tapes), the issue of homework, return talk-back links, the administration of examinations, and the awarding of degree credit are all powerful obstacles to national systems and arguments in favor of local and regional systems.

CONCLUSIONS

The UTA experience is with a largely incremental approach to extending graduate engineering education beyond the campus. The emphasis has been on replicating the in-class experience to the maximum extent feasible, rather than creating a new approach that is tailored to the limitations of the medium, or that uses to advantage the special characteristics of the medium. The candid classroom lecture, with all of its acknowledged limitations, has been found to work as well at a distance as it does in the classroom. Messengers deliver homework and term papers to be graded and return them to the students. Examinations are administered both at the plant site and on-campus, with the former being the norm for the intermediate examinations and the latter for the final examination.

The approach at UTA encounters no opposition from instructors or students, both of whom have long since become accustomed to it. Most importantly, it has been found to satisfy a well-understood need at a price that the university and private industry are willing to pay. There are obvious limitations on any system that relies upon broadcast television equipment. Improved resolution would be better. The ability to carry more courses per transmission channel would be highly desirable. The ability to transmit interactive graphics and simulations would also be highly desirable. However, all of these improvements must demonstrate not simply that they are better, as they surely will be, but that they are affordable and cost-effective. This is the challenge that faces the designers of improved systems.

The Florida-England Connection: A Telecommunications Project for Kids

M. D. Roblyer*

ABSTRACT

The "global classroom," until recently attended by only a few fortunate students, is becoming an increasingly large community. Linking up learners in distant locations for joint instructional projects is becoming more common every day. And, while there is no doubt that telecommunications activities can be enjoyable and educational experiences, the expense and preparation time involved makes it essential that they are also practical and efficient from an instructional standpoint. The Florida-England Connection is a two-year pilot project funded by the State of Florida's Department of Education (DOE) to demonstrate that using telecommunications to link students in different countries is as instructionally useful as it is technically feasible. This paper describes the instructional benefits of linking students long distance, the curriculum goals and activities designed for the project, some of the logistical factors which had to be addressed to make instruction work most effectively, and the strategies used to evaluate the project's success.

INTRODUCTION

Although not yet an everyday occurrence, telecommunications activities in education are no longer limited to the ideal "school of the future." However, the task of integrating telecommunications activities into mainstream school curriculum is still a difficult and often-neglected one. Many projects which link learners in different sites are rather unstructured and often focus primarily on providing students with "electronic penpals." In 1988, the Florida DOE asked the regional Panhandle Center of Excellence in Mathematics, Science, Computers, and Technology to show how such projects could go beyond being an interesting cultural exchange and become a part of a well-designed program to teach important school skills. The Panhandle Center, located in Tallahassee, was asked to design a sample curriculum, use the state's education network (the Florida Information Resources Network or FIRN) to link a school in Florida with one in England, and implement the instruction on a pilot basis.

Project personnel found that FIRN could be used to link up with Great Britain's network, The Times Network Systems (TTNS), which had many features useful for instructional projects. During the first year (1987-88), the project concentrated on accomplishing the technical tasks required to establish the FIRN-TTNS link and on identifying the kinds of curriculum which could be effectively taught via a telecommunications link between schools in different countries. The Academic Resource Center (ARC) in Tallahassee, Florida, was linked with the Andrew Ewing Primary School in a suburb of London, and a joint instructional unit was carried out during the summer 1988 session.

Now in its second year, the project is currently concentrating on showing how the resource investment required for online activities can be justified by the fact that they enhance classroom instruction in important skill areas and provide learning opportunities unique to this medium. Three schools are involved this year: the ARC, the Greenwood Middle School in Lake Mary, Florida, and a middle school in Devon, England.

A RATIONALE FOR USING TELECOMMUNICATIONS FOR INSTRUCTION

In reviewing findings of projects similar to the Florida-England Connection, project personnel found that linking students in different countries offers some unique instructional advantages. Among these are:

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- *Immediate access to up-to-date information* - Electronic exchanges among students allow them to obtain current information much faster than through any other medium. This can make a critical difference when information is changing rapidly or when immediacy of feedback is essential to a successful learning experience.

- *Broadening students' perspectives on issues* - When they learn about events and issues through traditional methods, students are often reported to have a feeling of isolation and distance from the subjects they are studying. "Conversations" with other students seem to make the topics more lively and interesting. "Electronic brainstorming" allows students to get the perspectives of people far different from themselves and often forces them to look at issues in novel ways.

- *Increased interest in and understanding about other cultures* - Talking online with students in other countries seems to encourage everyone involved to want to know more about each other. It is difficult to be intolerant of differences among cultures after such experiences, and there is evidence that students' attitudes actually become more positive after online interactions with students in other countries.

However, the project also found that the costs of telecommunicating between countries were rather high, with much of the expense resulting from Tymnet charges for sending files. Teachers involved in the project also acknowledged that it takes a substantial amount of time to plan and prepare for instruction which involves telecommunications. Project personnel concluded that, in light of the resources required for such projects, telecommunications-based instruction should probably be based on curriculum and activities which meet the following criteria:

- *Instructionally significant* - The goals and objectives set for the project should be directly related to important skills which are currently taught in school curriculum.

- *Systematically designed* - In light of the expense of online time, the curricular plan for teaching the skills should be structured and planned ahead of time so that the efficiency of both instruction and online time will be maximized.

- *Appropriate for medium* - Since telecommunicating as an instructional method is significantly more expensive and time-consuming than many other methods, it should not duplicate instruction which could be done in less expensive ways. Therefore, activities should be designed to take advantage of instructional features which only telecommunicating can provide. Online time is used for activities which benefit from immediacy of feedback and interaction with students to discuss important ideas and issues.

OVERVIEW OF CURRICULUM GOALS AND ACTIVITIES

The Florida-England Connection Project designed a semester-long instructional unit which meets the above criteria. It revolves around producing one issue of an "international newspaper" which contains editorials, late-breaking news articles, and letters to the editor on topics identified by the students at the beginning of the semester. By the end of the semester, students are to have accomplished the following goals:

Goal 1: Research Skills - Students will demonstrate research skills by:
-Using online information services, and print and other news media to collect data on a given topic
-Analyze information for relevance to topic
-Organize and structure collected information according to categories

Goal 2: Problem-solving Skills - Students will apply a problem-solving model by:
- -Defining the problem
- -Identifying and prioritizing possible courses of action
- -Applying decision-making aids to refine alternatives
- -Choosing the most appropriate alternative
- -Specifying requirements for implementing the proposed solution

Goal 3: Technology Use - Students will demonstrate use of technological resources:
- -Telecommunications software and hardware
- -Online systems such as information services, networks, bulletin boards, electronic mail
- -Desktop publishing software
- -Graphics software

Goal 4: Newspaper Production - Students will develop a newspaper by:
- -Designing a newspaper layout
- -Writing editorials and news articles

Goal 5: Focus on Global Issues - Students will be able to discuss or write about at least three issues of international concern by:
- -Stating the issue succinctly
- -Giving a summary of the factors surrounding the issue
- -Giving perspectives of various cultural groups on the issue
- -Summarizing alternative solutions to the problems

PREPARING FOR THE CONNECTION

This project addressed several kinds of practical concerns prior to beginning the instruction to help activities go more smoothly and result in a more successful experience for both teachers and students. These concerns included:

- *Selecting the school sites* - Schools were selected to meet certain key criteria. They had to have sufficient technological resources, a flexible curriculum which would permit use of innovative instructional methods, interested and skilled teachers who could devote time to the project, and a school administration which would support the project. To make sure that schools were compatible, efforts were made to match classes on the basis of age, grade level, and economic background.

- *Acquiring necessary resources* - Since the project was implemented with a minimum amount of funding, the following resources were determined to be the minimum essential ones: access to required equipment (microcomputer, modem, and telephone line) either in the classroom or very close to it; user-friendly software for communications, desktop publishing, word processing, and graphics; access to a network which allowed electronic mail/messaging, file transfer capabilities, and realtime "chats."

The following sequence of steps to prepare and carry out the instruction was determined to be essential for the success of this kind of project:

Step 1: Select sites and teachers - The lead site (ARC) was selected first, and other sites were selected for compatibility with it. (See criteria listed above.)

Step 2: Obtain necessary resources - Since one of the factors considered when selecting schools to participate was the availability of technical resources, most required items should already be in place at this time.

Step 3: Design curriculum - Although time constraints required that curricular activities be designed by the Project Director and the ARC teacher, ideally all sites should be involved.

Step 4: Learn networking procedures - To assure that instruction proceeds efficiently, each site must become proficient in procedures used for connecting to the network, sending files, sending E-mail and messages, and transferring files.

Step 5: Establish communication among teachers - To optimize online time, all of the teachers need to be in contact long before instruction begins, and all should agree on procedures to be used, such as when they will contact each other and in what format information will be exchanged.

Step 6: Send copies of curricular materials to participant schools - The Teacher's Manual which documents the curriculum and instructional responsibilities at each site should be sent to all participants.

Step 7: Administer pretest measures - See Evaluation section below.

Step 8 : "Introduce" students long-distance - To facilitate communication among sites and make the most of the opportunity for increasing cultural awareness, personal introductions should be a first step in the instructional unit.

Step 9: Do instructional activities - A curriculum of 18 weeks or longer seems essential for accomplishing any meaningful activities.

Step 10: Administer posttests - See Evaluation section below.

EVALUATION STRATEGIES

While projects such as this are often described in glowing terms by teacher and student participants, personnel in the Florida-England Connection Project felt it was important to develop some measurable means of establishing what the project accomplished. Several instruments are being designed for this purpose:

- *Attitude Measure* - Changes in students' attitudes toward persons from other countries are measured through a semantic differential. Each item is a pair of "opposite adjectives" which can be used to describe people from a given country, e. g.:

Good ______ ______ ______ ______ ______ Bad

Students place an "X" on the space which indicates the degree to which one of the adjectives best describes their opinion.

- *Achievement Measures* - Measures of achievement in problem solving and current events are also being designed. Instruments which gauge students' knowledge of global issues will be based on the topics students select during the semester.

CONCLUSION

The results of the first year of the Florida-England Connection Project indicate that online interaction between students in different countries can indeed have a positive effect on students' perceptions of people in other cultures. The primary goal of this year's activities is to demonstrate that these interactions also have immediate practical significance in terms of learning important school skills. To have any real impact on education, the "global classroom" must be an instructionally useful, as well as interesting, place for students to visit. This project seeks to provide some concrete guidelines for how to make links between students in different countries an integral and valuable part of classroom instruction.

TEA-NET: TEXAS EDUCATION AGENCY ELECTRONIC COMMUNICATION NETWORK MODEL DISTRICT PROGRAM

Connie Stout*

ABSTRACT

During the past year the Texas Education Agency (TEA) conducted an experimental project to study the results of two school districts using electronic communications for distributing information and messages while eliminating most of the paper distributed among the campuses for these same purposes. The districts, using THE ELECTRIC PAGES an electronic mail, bulletin board, and teleconferencing network, were able to communicate with the Agency and other educational and professional entities. This paper summarizes the findings of the electronic network. It also describes some of the features and benefits of the Texas Education Agency's electronic network.

INTRODUCTION

The two school districts involved in the model district project were North East ISD and Judson ISD. Both districts are located in the San Antonio area. North East ISD has 41 campuses with an average daily attendance (ADA) of about 38,000 students. Judson ISD has 15 campuses and an ADA of about 12,000 students. In September, 1987, personnel from TEA and GTE Education Services (THE ELECTRIC PAGES) visited the model districts and interviewed superintendents, coordinators, and teachers to determine their experiences, attitudes, and recommendations about using the district electronic network to communicate within their districts and to communicate with other districts throughout the state. Based on their feedback, a model implementation plan has been designed to be used by other districts that are considering implementing such a district-wide network.

NETWORK DESIGN

Texas has nearly 1100 districts and over 6000 campuses. This number makes it technically very difficult for all campuses to access THE ELECTRIC PAGES' host computer in Austin. In addition, the connect charge would be cost-prohibitive when looked at from a state perspective. THE ELECTRIC PAGES' electronic network is configured to handle the volume that would be demanded by the approximate 1100 districts in Texas by establishing a distributive host system. This network system has three major components: 1. a mainframe host computer located in Austin; 2. a personal computer with the local network host software (InfoExchange) usually located in the central office; and 3. a personal computer operating the communication software (InfoAccess) located at each site. The model district's local host computer accesses THE ELECTRIC PAGES host computer in Austin via 1-800 telephone lines. All of the communication sites located in a district access their local host via local telephone lines using InfoAccess.

During a typical operational cycle, the local network host operating InfoExchange automatically initiates a call to THE ELECTRIC PAGES host in Austin. These connections usually occur at night when connect rates are reduced. The local network host computer receives updates from TEA, other professional organizations who stored information on THE ELECTRIC PAGES, as well as all mail for the users of the local network system. At a later time, local users run InfoAccess on their personal computers to log on to their local host computer. The computer retrieves their mail, retrieves information that has been downloaded from THE ELECTRIC PAGES host computer, and sends the local user's mail.

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Used in this manner, the local user does not incur a connect charge when accessing information on THE ELECTRIC PAGES. The network design is one that gives administrators, teachers, and students access to information and mail from across the state without each incurring the burden of a connect cost.

BENEFITS FOR ADMINISTRATORS

One of the major benefits of the use of the system was, for the first time, administrators wanted a computer on their desks, and they wanted to use it. Using a computer to communicate with their peers gave principals and central office administrators the incentive to begin learning to use the computer for word processing and spreadsheet applications as well. Another benefit noted by administrators was in the area of time savings. These savings occurred in memo transfer, elimination of telephone tag, tracking of maintenance records, processing work orders, and general personnel services.

Feedback from the two model districts suggested that the project put the administration on-line with technology. Before the model district project, both districts had difficulty getting administrators to use computers. Although some of the initial reaction was negative (eg. some administrators were hesitant about using a computer) the attitude toward the project was positive by the end of the year. The system at both districts was used extensively by elementary and secondary principals and the principals' secretaries. The experience demonstrated to the administrators that computers could be used for applications other than attendance. An additional positive benefit that the administrators reported was that district-wide communication was generally more effective.

INSTRUCTIONAL BENEFITS

An additional positive result was seen when telecommunications spilled over into the curriculum. Because a technical assistance person was needed on each campus, the computer literacy and computer science teachers in North East ISD were trained to use the technology. These teachers had an overwhelmingly positive response to the training. They felt the "local host" was imperative for the use of instructional telecommunications within a district. Students enrolled in the 7th grade computer literacy course used the technology by maintaining a bulletin board on the local host. The "sysop" or systems operator function was transferred from middle school to middle school on a monthly basis. Once a month the teachers met to work on telecommunication projects. During the past summer, the teachers met to develop ways to integrate telecommunications into the computer literacy curriculum.

As a result of this positive reaction in North East ISD, instructional applications have grown to such an extent that the district chose to dedicate a computer to run InfoExchange solely for instructional applications in addition to the computer that runs InfoExchange for administrative applications. The ten middle schools which offered computer literacy in the 7th grade acquired a phone line for each computer lab. The district revamped their computer literacy curriculum to include telecommunications. This approach proved positive as it allowed teachers to be involved in the development of the new curriculum. The model district project coordinators reported it created a positive need for teachers and students to become involved in telecommunications. Every 7th grade student at NEISD was able to participate in the project. The model district project coordinators felt that students involved in the project were given opportunities to expand problem solving skills. Although the application was limited to the students enrolled in computer literacy, the district is looking at ways to expand into other academic subject areas.

TRAINING

A primary reason for the positive reactions to the system in both districts was the training and support provided by the district coordinators. Although training was managed differently in each district, both coordinators admitted it was a critical component to the successful implementation of the network system. Both districts offered a six hour, "hands on" training session for administrators and the building secretaries. North East ISD also included teachers in the training. An additional nine hours of training was offered by North East ISD during the summer for those who wanted to learn to integrate word processing into telecommunications and on-lines skills.

Both North East ISD and Judson ISD took the approach of training the building administrators first and then training the teachers. Their reasoning was that it was critical to get administrators involved with the new technology and show them how it could make them more effective. The coordinators thought that the administrators would be more receptive to curriculum and instructional applications in a system they used themselves. As a result, they would be more likely to help procure the resources needed for instructional uses in the future. Too frequently, the coordinators reported, one could get support for administrative applications, but not instructional applications.

INNOVATIVE APPLICATIONS

Judson ISD initiated a very interesting project through their local network. They posted information on one of their bulletin boards and made it available to the parents in their community. They published an "open" ID and password enabling any parent who had a computer, modem, and communication software access to the information on the Judson Public Information Bulletin Board. The response was quite positive as it gave parents, and the community in general, immediate access to school information such as calendars of meetings and results of various competitions.

PROBLEMS

There were three major problems noted:

- Insufficient equipment was viewed as a problem. Although existing equipment was used in both districts, additional funds were needed to update some computers. At North East ISD, the elementary schools ran the system on two disk drive systems. Although the equipment was sufficient to run the software, it was not the preferred configuration.

- Turnover of personnel also was a problem. This emphasized the need for continual training for personnel.

- Both model district project coordinators noted that the time it took to start-up the project and maintain it early on was significant. While this was not unexpected, it still caused some difficulties.

RECOMMENDATIONS

After a number of months with the project, both districts had quite a few recommendations. The following were the major suggestions that were common to both North East ISD and Judson ISD.

- Provide sufficient funds. In order for this to work, the district must put money into it for hardware, software, connect time, staff time, etc. The district coordinators believe it will save time in the long term, but initially it takes time to get the system set up and running.

- Require initial training. In the case of North East ISD, the coordinators felt the two-day session provided by THE ELECTRIC PAGES gave a critical perspective on how to set up and run the electronic network. They believed this initial training was critical for the successful implementation.

- Make sure a thorough training program is planned and carried out by the district coordinators. Require a minimum of twelve hours of telecommunication awareness and hands-on training for administrators, secretaries, computer literacy and computer science teachers in the district. Training can be done in summer as well as throughout the school year. Network training can be combined with word processing training.
- Require a contact person for each campus to serve in a support role. Have these people trained by the district coordinators who have been trained.
- Require a district-wide adoption of one word processor to ease the support of file transfer functions.
- Train central office personnel first, then campus personnel. North East ISD trained campus personnel first but their recommendation is to train central office staff first so that they can begin to see first-hand the benefits of a state-wide electronic network.
- Make the use of electronic mail mandatory throughout the district.
- Develop a local area network (LAN) version of THE ELECTRIC PAGES software to eliminate the use of modems at each site.
- Dedicate one person to develop the applications to be used with the telecommunications system.
- Work more closely with people within TEA to get more and better information on the TEA Bulletin Board.

CONCLUSIONS

Both district coordinating staff who were in charge of the day-to-day operations believe telecommunications for administrators and students is something which cannot be ignored. One coordinator remarked that if we are going to prepare our children for the future, we as administrators must also get involved and learn, at a minimum, what we are requiring our children to learn. If knowing telecommunications, word processing, databases and spreadsheets are a minimum concept for children in 7th and 8th grades, then we must see that administrators know those skills as well. It is essential, they believe, to prepare children for the technology which they will encounter in colleges and business after they exit from the public schools.

One elementary principal noted that he felt it was a way for teachers to feel as though they are a part of the mainstream of education in Texas and not totally isolated in their classrooms. The teachers had been particularly thrilled to read the full text of a speech Dr. W. N. Kirby, Commissioner of Education, had given the previous day. Normally, the teachers only saw excerpts of speeches in the news. This way they were able to get the full story on an issue of great importance to them.

Since the conclusion of the Model District Project in August, both districts are expanding their local network to make it available to more administrators, teachers and students.

PLANNING STRATEGIES FOR INSTRUCTIONAL TECHNOLOGY:SCHOOL DISTRICT AND SITE GOALS

J O'Neill

ABSTRACT

The key to successful implementation of technology into the education process involves visionary strategic planning and leadership. The need to address not only current uses of technology but the possible applications of tomorrow is paramount. The time which elapses between understanding how to employ technological developments and making them a reality is probably what prompted Paul Harvey to say, "Progress at its most accelerated rate is agonizingly slow." We must not lose sight of the long term potential benefit technology can afford us when it takes a long time to move from conception to reality.

An Instructional Technology Planning Proposal needs to be developed to provide strategic goals for better utilization of technology in instruction. The lack of a master plan has resulted in many different directions being adopted by schools and departments. There has also been a lack of training and evaluation for most technology projects. A Planning Proposal addresses these deficiencies and includes consideration of the following elementa: needs assessments, efficiency, effectiveness, consistency, equity, compatibility, applications, maintenance, facilities, networking, training, research, diversity, and evaluation. The content and methodology goals of the Planning Proposal should also been aligned with District goals for instruction.

The Instructional Technology Planning Proposal is an evolutionary document. Technological advances along with research and evaluation will demand periodic alterations and adjustments during the implementation period.

San Bernardino City Unified School District, CA, USA

THE PLANNING PROCESS

This proposal and the planning process was the responsibility of the Coordinator of Instructional Technology. Following is the timeline which identifies the components and architecture used in the planning proposal process.

PHASE I -- PRELIMINARY ACTIVITIES -- March 1988

1. Identify Leadership and form Committees
2. Identify and assess existing equipment and resources
3. Develop and conduct instructional technology needs assessment survey
4. Collect additional information and data from other school districts and states
5. Create basic principles and expected outcomes

PHASE II -- STEERING COMMITTEE DIRECTS PLANNING -- April/May 1988

1. Determine instructional technology philosophy for District
2. Review needs assessment and identify needs according to survey
3. Develop goals and objectives for each component of instructional technology: curricular plan, staff development plan, and instructional management plan

PHASE III -- WRITING THE PROPOSAL -- June 1988

1. Determine action and purchase plans for hardware including timeline and budget
2. Develop a process for software preview, selection, and evaluation
3. Develop a materials and equipment support system
4. Develop a monitoring and evaluation component
5. Finalize plan and present to the superintendent's staff for input and modification

PHASE IV -- PROPOSAL PRESENTATION -- November 1988

1. Revise the plan and prese

PHASE V -- IMPLEMENTATION -- 1988-1991

1. Monitor, evaluate, and update

GOALS

I. Computers and other technologies will be used at each school site to improve the quality of instruction including the ability to access a rapidly expanding knowledge base.

II. District planning will maximize the long term utilization of existing and future hardware and software acquisitions through creative logistics approaches.

III. An extensive and ongoing staff development program will be established to allow for the effective implementation and use of technology.

IV. A "High Tech - High Touch" instructional approach at all levels (K-Adult) will allow students to become exposed to technology using interactive strategies throughout the curriculum.

V. Attention to equity and continuity issues will be maintained and focused to address the needs of different student populations (eg. Bilingual, Special Education, Categorical, GATE, D.& I., etc.).

VI. The Computer Literacy curriculum will be updated to allow students to understand computers, as well as other technologies, and their applications and implications in society. Students will develop the skills necessary to intelligently and successfully interact with computers and use them as productive tools.

VII. Research, Developement, and Evaluation Services will be utilized to identify, monitor, and assess effective educational uses of technology.

VIII. New and refurbished school facilities will include the physical enhancements necessary for the use of current and future technologies.

IX. Partnerships in technology applications with institutions, businesses, and parent groups will be established for purposes of direction, training, funding, and other needs not yet identified.

X. Curriculum software and hardware evaluation teams will be established to preview and evaluate software and hardware.

XI. Procedures will be developed for selecting and implementing pilot programs at school sites.

A CURRICULUM-BASED MODEL FOR MIDDLE SCHOOL COMPUTER INTEGRATION

J. E. OWENS[*].

ABSTRACT

Effective integration of computers in the middle school curriculum requires a program that: 1) provides uniform access across students; 2) minimizes technical knowledge needed by the classroom teacher; 3) supports, rather than supplants, the existing curriculum; 4) fosters individual initiative and allows flexibility across teachers and subjects; and, 5) maximizes use of computer resources. The proposed program meets these criteria through a year-long resource model utilizing applications software and introductory programming experiences coordinated within the middle school curriculum.

INTRODUCTION

Instructional patterns of computer usage tend to fall into two categories: out-of-class laboratory instruction, typically taught by "computer" teachers, and in-class instruction by the subject matter instructor. Each model is limited in its ability to fully integrate computer experiences within the middle school curriculum.

In-class models, characterized by the subject matter teacher providing instruction in the classroom or in a laboratory setting, provide clear integration of content but require each teacher to become trained in computers and software. Teacher objections and inadequate training often doom this model to sporadic and uneven implementation; duplication of effort may occur.

Laboratory models based on a fixed-term course (perhaps a twelve week computer segment in a year-long rotation of computer/art/music) pose a problem for the classroom teacher intent on integrating the computer into classroom activities. Since few schools are equipped to instruct all students in computer usage simultaneously, classroom teachers are typically faced with a mix of students who have computer experience and those who do not. This process often results in "computer competency" or "computer literacy" courses removed from the content of the academic curriculum.

Schools using a team approach may alleviate this problem somewhat by scheduling a team into the computer course during each session. While this model allows for easier integration, computer instruction is concentrated over a short period rather than spaced evenly over the entire year. Teachers integrating computer usages with their classes must compete for time over a short period.

The model proposed here is a variation of the laboratory method that realizes the integration potential of the team approach, while allowing each student to access the computer for the full year. Team or non-team scheduling approaches may be followed. The focus of computer utilization is on applications software that can be used across subjects (word processing, database) and programming.

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Other subject-specific applications such as data collection and measurement activities in science classes are more amenable to non- laboratory approaches. These may be more efficiently embedded in the curriculum by one-machine whole class instruction or small group work within the regular classroom.

THE MODEL

A daily rotation schedule allows each student to use the computer for the entire school year. In this approach each class is scheduled to meet in the computer lab every third day. On the remaining days of the rotation students may be involved in other typical rotation courses (e.g., art and music) or the rotation may involve one day of computer alternating with two days of another subject (e.g., physical education).

This schedule offers two advantages over a traditional daily class: 1) all students work with the computer in a formal setting on the same schedule for the entire year; and, 2) time between class meetings allows for the regular classroom teacher to more fully integrate the academic subject with computer work.

For example, a social studies teacher may have a class develop a database on a current topic. Through the rotation all students will use the laboratory over a three day span. Since more time is needed to discuss relevant categories and research data than is necessary for creating the database, computer use takes on a role as a beneficial adjunct to the lesson rather than the driving force.

Since the computer database is constructed in the laboratory, the classroom teacher does not need a detailed technical knowledge of the hardware and software. Thus academic class time is reserved for the development of concepts, generalizations, and skills associated with the content being studied, not with building skills associated with computer usage.

RESOURCE UTILIZATION

The amount of time spent by each student on the computer is obviously a function of the available equipment. To allow adequate time for instruction and use of applications each student should be scheduled for a minimum of one hour of individual access every three days. Schools with a higher computer-to-student ration may use a two day schedule. Four factors are involved in determining equipment utilization: number of class periods per day, numbers of students to be served, number of days in rotation, and number of computers in the laboratory (at least one computer should be designated as a spare and one as a teacher machine). Knowing (or assuming) any three of these factors allows calculation of the fourth using the formula shown in Figure 1.

Fig.1 Equipment needs calculation

$$\text{Sections/Day} = \frac{\text{Number of Students}}{\text{Days in Rotation X Computers in Lab}}$$

Examples	
Number of Students: 250	Number of Students: 180
Computers in Lab: 17	Computers in Lab: 20
Days in Rotation: 3	Days in Rotation: ?
Sections/Day: ?	Sections/Day: 5

$$\frac{250}{3 \text{ X } 17} = ?$$

? = 4.9 (approximately)
Use 5 Sections/Day

$$\frac{180}{? \text{ X } 20} = 5$$

$$180 = 5(? \text{ X } 20)$$
$$= 100 \text{ X } ?$$
$$? = \frac{180}{100} = 1.8$$

Use 2 Day Rotation

IMPLEMENTING THE PROGRAM

Curriculum development for integrating computer applications follows a five-stage process of pre-planning, introduction, planning, implementation, and reflection/revision.

Pre-planning. Pre-planning includes the selection of a computer- implementation committee comprised of the computer resource teacher, an administrator, and a representative from each academic subject. This committee is charged with evaluation of hardware needs and availability, selection of software, determination of schedule, and preparation of in- service workshops for the remaining teachers.

Introduction. Prior to the beginning of the school year, the computer-implementation committee meets with classroom teachers in the academic subjects to demonstrate software and discuss classroom implications. Resources from the literature in each subject field are demonstrated and/or distributed--these include curriculum-based articles (e.g., from Arithmetic Teacher, Science Teacher) and commercial products (e.g., Bank Street Filer School Databases). Time frames and schedules are presented. Teachers unfamiliar with software and/or hardware are scheduled for workshops.

Planning. Planning is done within the academic subject department. The implementation committee member for the department is charged with communications between the committee and the department. Teachers supply the content for consideration in the laboratory and grade the resulting output.

For example, language arts teachers might supply articles incorrectly punctuated or capitalized, articles for the students to change from present to past tense, or writing assignments. The laboratory teacher is responsible for developing student usage of the word processing software (including spelling checker, thesaurus, and printer), assigning students grades on the criteria of technical competence. Grading of content, however, is left to the subject matter teacher.

Fig. 2 Software evaluation criteria

Quality: Reliability, vendor/manufacturer support
Ease of Learning: Tutorials supplied, appropriate for grade level
Ease of Use: Clear on-screen instructions, readily available help screens, logical key combinations
Price: Initial cost, availability of site licenses/lab packs, multi-load programs, cost of updates
Flexibility: Usable across grade levels and subjects
Documentation: Extensive and well-written documentation included, telephone support available
Supplementary Material: Curriculum material available or supplied, supported through professional literature, teacher utilities included where appropriate
Full use of Capabilities: Upper/lower case supported, printer functions supported, color/joysticks, etc. where appropriate
Transferability: Software is available for Apple, IBM and compatibles, Commodore, etc.

Work assigned for the laboratory must fit within certain bounds set by the software and the level of student expertise. However, it is not necessary for each teacher to require identical work. In the example above, one teacher might assign capitalization work, another punctuation. To the computer teacher these lessons are equivalent uses of the software.

Implementation. The sample implementation schedule shown here (Figure 3) allows a three week introduction familiarizing students with keyboarding skills (a proficiency of 15-20 words per minute is recommended) and disk handling and printer procedures. Four six-week sessions follow integrating word processing (language arts), database (social studies and science), and programming (mathematics) into the curriculum.

Word processing was chosen as the first application due to its uses across the curriculum. The database is next because, in the cases of Bank Street Writer and Filer, a similar command structure makes the transition from word processing to database easier. Programming involves LOGO for geometry or BASIC for number theory. A three-week session using graphics and/or music can follow, integrating with art/music classes.

Finally, a six-week project is planned. Students contract with one of their subject matter teachers to develop a project involving one of the applications previously studied. Creation of a local history database, development of a class or school newspaper (using a desk top publishing package, perhaps), or developing a series of programs or solving a mathematical task using programs are examples of projects.

Fig. 3 Sample student schedule - 3-day rotation

Weeks	Subject	Software
1-3	Computers	Typing Tutor IV/Print Shop
4-9	Language Arts	Bank Street Writer III
10-15	Social Studies	Bank Street School Filer
16-21	Science	Bank Street School Filer
22-27	Mathematics	LOGO (Geometry) or BASIC (Number Theory)
28-30	Art/Music	Varied
31-36	Projects	Newsroom, Any of above

Reflection/Revision. Curriculum revision is a cyclical event; each year's activities must be evaluated in order to improve. Since the main thrust of the model is integration, meetings of the implementation committee with the faculty in each area affected provide the most useful analysis.

CLASSROOM USES

The uses described here are those more appropriate for laboratory instruction. Other uses are more appropriate for in-class instruction using one computer with an entire class or for small group work. This is particularly true for mathematics and science classes. In mathematics, for example, function plotters can play a critical role in developing students' conceptions of function; in the science class, the use of computers as laboratory instruments (with temperature probes, blood pressure gauges, etc.) both models the real-world role of computers in science and provides dynamic examples of nature's forces at work.

SUMMARY

Word processing, database, and spreadsheet applications are credited with the proliferation of the microcomputer in the business world. In the middle school environment word processing and databases, in particular, promise to alter both content and methods of instruction. Introduction of the computer in the school must, however, follow one simple dictum: Instructional objectives must be better served, or at least equally well served, by the computer than by conventional means.

Databases offer science and social studies students a powerful tool for organizing data in a manner that facilitates generalizations. Programming provides mathematics students with rich patterns from which mathematics can grow and tools for problem solving activities. In language arts the word processor relieves the tedium of rewriting by hand, allowing the student to concentrate on editing tasks. In an environment that develops computer proficiency as a support to the curriculum, both computer literacy and academic learning can thrive. Relieving the classroom teacher of the responsibility for technical minutiae while supporting the teacher's role as curriculum developer can pave the road

Selecting School-Appropriate Instructional Uses of Technology

J Hixson

ABSTRACT

Each day, more schools turn to technology-based systems and programs to enhance classroom instruction and school effectiveness. This decision triggers a complex, and often confusing process in which the school attempts to select a technology-based system(s) or program(s) which fits the school's needs and resources. The selection process is complex because, as research and practice demonstrate, any change in one element of the school's instructional program has implications for all other elements, and for district-level mechanisms which support the instructional program. The selection process becomes even more complex when one considers the rapid expansion of hardware and software available to educators/schools.

This presentation describes a process by which a school can select appropriate technology-based systems/programs. In describing this process, the presentation will focus on a manual currently being developed by the North Central Regional Educational Laboratory for use by school personnel, that describes and provides examples of: basic steps in the process, resources required, and personnel who must/should be involved. The process described is grounded in research and experience in the areas of: school effectiveness and improvement; instructional and administrative leadership; strategic planning; organizational change; instructional strategies and curricular design; as well as current and emerging trends in educational applications of technology.

The presentation also addresses what a school must know about its instructional program, related support mechanisms, and the technology-based system under consideration, to make a reasonable judgement about the instructional soundness of the system/program, the "fit" of the system/program to the school's overall instructional goals and strategies, and the adjustments that may be needed to accommodate the system/program effectively. Additional issues discussed include: assessment of instructional effectiveness, curriculum alignment and staff development.

Also, because the presenter is very interested in audience reactions and experiences with selecting technology-based systems/programs, time will be devoted to audience questions and discussion.

North Central Regional Educational Laboratory, IL, USA

NEW TECHNOLOGIES AND EDUCATION AT I.N.R.P.

Bernard DUMONT*

ABSTRACT

The Department of New Technologies at I.N.R.P. is leading research in five directions :
Artificial Intelligence, Technological Imageries, Distance Learning, Influence of N.T. on contents and methods in teaching of "classical" disciplines.

PRESENTATION OF I.N.R.P.

The National Institute for Pedagogical Research is part of French Ministry of Education. It' working with full time researchers (in Paris) and secondary school teachers (everywhere in France) who receive time (or money) to participate in our research. We also work with teachers from "Ecoles Normales" where primary school teachers are trained. Several teams are associated with university professors. So, our research is permanently linked with the real life of schools. It's the originality and the strength of our Institute.

THE DEPARTMENT OF NEW TECHNOLOGIES

Our main mission is to study the impact of New Technologies of Information and Communication (N.T.I.C.) in the French educational system. We are 26 full time researchers and almost 300 associated teachers. We are working with universities and public laboratories as well as private ones. We are also involved with international cooperation projects (Canada, Argentina, Uruguay, Brazil, Nederlands, Great Britain, Morocco). Our works involve not only microcomputers but also telematics, videodiscs, compact discs, television, ... As part of the French Ministry of Education, werhave to give to teachers and students as well as to those who have responsability to design curricula or teachers training programs, ideas and informations about what can be done, with N.T.I.C. in Education, nowadays and tomorrow.

ARTIFICIAL INTELLIGENCE

In this orientation, we are taking into account change in technologies, going to more userfriendly computers and new possibilities to access and to organize informations and knowledge (expert systems, Knowledge Based Systems, ...). For education, A.I. presents an interesting

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value : it is a meeting place for informatics with linguistics, cognitive sciences, brain sciences. We believe that the present work done in A.I. can give important results for learners in a few years.
Four research are presently going on in this area :
1) reasoning in mathematics (particularly with a system called FRACT, based on children's errors in calculus of fractions),
2) problem solving in chemistry (evaluation of students proposals, diagnosis of errors),
3) reasoning in ethology, i.e. in the study of animal behaviors (simulation of experiments, deduction from results, guides for students reasoning),
4) reasoning on images databases as videodiscs (how to "circulate" through several thousands of images? How to compare students knowledge with an expert system knowledge?).

TECHNOLOGICAL IMAGERIES

Outside classrooms, students get a lot of informations from images. But with N.T.I.C., they get also new ways to access, to process, to produce or to stock images. Research is necessary to introduce in schools and in teachers training change resulting from these new representations of knowledge. We are particularly working on :
1) new functions of visualisation in scientific activities in elementary schools,
2) influence of images from scientific popularization on adolescents representations of technology,
3) analysis of building and use of interactive products,
4) building notions of geographical space and historical time, depending on different types of images and holders,
5) experimental activities on images, through a computer, in physics (observation, measurement on images, theorical constructions), adaptating methods from research laboratories.

NEW TECHNOLOGIES FOR DISTANCE EDUCATION

Because of a large needs of a very diversified public, distance education is getting important in our developed societies where adults have constantly to change or extend their knowledge. New technologies are not used as often as one can imagine, even in France, where telematics is very spread. It's also difficult to know what are the reasons of choice of a media, where is the impact of its use, the effect on learning. With a lot of small experiences and without a national structure (as an Open University), France presents an interesting situation to study.

INFLUENCE OF N.T.I.C. ON CONTENTS AND METHODS OF TEACHING

Scientific knowledge and methods have been deeply influenced by informatics and other technologies. In this orientation, we try to transpose these changes to school environment in various disciplines as mathematics, physics, biology, French, history and Latin.

TELEMATICS AND EDUCATION

The main aspects in this orientation : new access to information and new ways of communication.
Three research take place here : evaluation in mathematics (with multiple choice questionnaires), multimedia tools for scholar and professional orientation, and communication at primary school level.

KEEPING TRACK TEXAS STYLE

Patrick Deviney*, Lois Hagen•, Billie Kennedy•.

ABSTRACT

With fewer dollars and greater demands on resources, school districts can no longer afford to neglect modernization in the field of maintenance management. The Bastrop Independent School District, in south central Texas, leads the state with its implementation of a computerized maintenance management system that provides unit cost data, control of inventory and assets, a preventive maintenance program, and a work-order module. With the implementation of the ACT 1000 Maintenance Management System, which requires no prior computer experience to operate, Bastrop is meeting its goals of a safe, efficient , and cost effective maintenance program.

The past decade has seen school districts' revenues continue to decline and their expenditures continue to increase. Because of this trend it becomes imperative for the well being or even survival of a school district that they efficiently manage all aspects of the district's operation including the management of their physical plants, buildings, equipment, and inventory. Legislators and the general public are demanding that educational systems demonstrate both efficiency and excellence. In response, effective schools are seeking to become more accountable for their products. Likewise, effective school districts must become more accountable for the dollars they spend. A computerized maintenance management system enables a school district to obtain per job costs of labor and supplies, to account for per site utility costs, and to print out a report of the data in only a few minutes. A previously unthinkable task now is a snap.

Today, school districts turn increasingly to the computer to maintain student and staff records, and to balance financial accounts. However, in many districts across the United States, whether they be large or small, urban or rural, maintenance needs and inventory, the processing of work orders and

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and records on preventive maintenance are being kept by hand. At a time when every dollar must count, and be counted, there is hardly a facility which would not be able to justify a computerized maintenance management system.

Without a computerized maintenance management system, data and records are left dormant in file drawers and patterns in supply needs or workers' productivity are never identified. When maintenance needs and inventories are maintained by hand the inventory usually contains expensive unused items and many times doesn't have the materials and supplies needed for emergency repairs. System down time and time lost waiting for these supplies is costly. Computerized inventories does aid in the efficient use of the resources at hand; can help ascertain the pattern of supply usage; and will facilitate the ordering of materials and equipment with sufficient lead time. The computerized preventive maintenance program helps identify life threatening situations and reduces excessive energy consumption due to faulty and out-dated equipment. It also enables a district to pre-plan preventive maintenance servicing of equipment and to schedule the work orders during the year's slack periods.

Efficient use of people's time is the key to making a system run smoothly. Maintenance workers spend a great deal of their time waiting around, meeting, and traveling. Some trade journals report that up to 60-70% of workers' time is spent in this non-productive mode. A computerized work order system eliminates the productivity killers of unclear assignments, waiting for assignments and parts, and unneccesary travel time. In addition, asset control becomes easy when tools are assigned to each employee and these assignments are recorded in the computer.

The Bastrop Independent School District (ISD), a district of approximately 4,400 students, has become a leader in managing its "breakdown" and preventive maintenance programs. Bastrop is the first district in the state to use the ACT 1000 Maintenance Management System from Applied Computer Technologies. This system, developed solely and specifically for schools, has enabled the district to "track" its work orders, employee productivity, supply needs, and maintenance requirements. The work order system allows the district maintenance director to know how many work orders have been filled and how many are pending. It also prints out new orders and can automatically compute the response time averages. Supervisors note that individual worker's reports have even stimulated healthy competition among the workers.

The ACT 1000 system uses a variety of modules which address specific areas of a modern maintenance program. An energy module provides the district with data to keep track of its electrical, gas, water and sewer costs at both campus and district levels. By referencing the historical cost patterns, a more accurate budget can be prepared. The mechanical inventory module can provide a report of items received, a list of supplies currently in the inventory, a list of those used for each work order and compile a future purchase order. Using this module, Bastrop ISD has been able to reap the economic benefits of having needed supplies consistently available from the inventory. The janitorial supply inventory is also kept on this system with reports similiar to those in the mechanical inventory module. This computerized maintenance management system has helped us meet the goals of a safe, efficient and cost effective school district.

It is reported that there were no problems with implementation of the system. Representatives from Applied Computer Technologies helped install the system and trained personnel in its use. On the very first day of installation staff members were able to produce a simple report on work orders and the janitorial inventory. As previously stated, the system is simple enough that one can begin to use it with no computer experience. Whenever there is a question, the consultants are only a phone call away. Unlike most maintenance management software, the ACT 1000 system has been designed exclusively for school maintenance departments. As new ideas and input are collected, the program is updated and a new program disk is sent to current users. With the purchase of the Act 1000, the entire program and all the assistance and support needed to begin an efficient, effective computerized maintenance management system is assured.

TECHNOLOGY AND SCHOOL BASED MANAGEMENT

FRANCIS C. THIEMANN*, THOMAS S. JEFFRIES*

ABSTRACT

A work flow budgeting formula, developed by Sanders and Thiemann[1] for management control in decentralized school systems, is presented along with the technology required to gather, process and store the data.

INTRODUCTION

As funds to support education continue to be scarce, as the demands for accountability increase, and as the realization that standardized delivery systems do not meet the needs of specific schools or children, school districts must turn from highly centralized control to more decentralized management styles. The emphasis in recent years on school based management requires that administrative preparatory programs offer future principals the understandings and skills needed to operate in this more complex environment. While there is a need to train potential administrators in more open styles of management that involve the total staff, students, parents, and community, it is imperative that principals understand the information systems, line item and work-flow budgeting process and the technology that is required to carry it out.

In this paper, we will discuss a procedure taught at the University of Louisville that details costing students through the objectives in each course taken. Specifically, we will discuss how technology is used to analyze cost and performance. The issue of costing a student through a program has been alluded to since the late 1960's, but no methodology for generating this data has been suggested. Our program focuses upon the services or outcomes at the district, school, program and course level. Information thus generated allows relevant decision makers to set goals and objectives that meet the needs of their clients, to allocate resources more effectively and to establish the criteria by which they will be held accountable.

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[1] K.P. Sanders and T.C. Thiemann, Challenge, 19, 3:34-41, 1980.
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DEVELOPING THE FORMULA

Costing a student through a program is dependent on the availability of the necessary district data. It is assumed that the district central office has the necessary financial data needed for implementing a cost procedure. In its simplest form, the equation for per pupil cost in a school district is: $P=\Sigma c/\Sigma s$ where per student costs = sum of all costs divided by sum of all students. Moving from the initial formula of a gross measure to the final equation yielding individual students costs entails several derivatives. In this paper only four derivatives are presented since they appear applicable to most systems. Unique district and school needs or characteristics may require an estimated 10 to 15 additional derivations.

Based on Reason and White's[2] Classification of Expenditure Accounts the costs each classification of expenditure was assigned a notation as follows:

C1	salaries of teachers
C2	salaries of local school administrators
C3	instruction supplies, equipment
C4	clerical staff
C5	salaries department heads, supervisors
C6	AV supplies and library
C7	guidance and psychological services
C8	food services
C9	transportation
C10	substitute teachers' salaries
C11	central office administrative staff salaries
C12	administrative supplies and equipment (central)
C13	staff welfare services
C14	physical plant operation
C15	physical plant maintenance
C16	debt service-bonded indebtedness
C17	central office maintenance and operation

It is recognized that the expenditure list as developed by Reason and White is incomplete but is adequate for developing this work flow budget formula. Based on the classification system the costs are divided into the following categories:

C1,C3,C6,C10,C14,C15,C16	Local School-actual costs
C2,C4,C5,C7,C8	Local School-prorated costs
C9,C11,C12,C13,C17	Central Office-prorated costs

These categories can be symbolized as: X=local school actual, Y=local school prorated, and Z=central office prorated.

[2] P.L. Reason and A.L. White, U.S. Government Printing Office, 1966

n+3 Derivation

To arrive at a per pupil expenditure (P) for a particular school, the equation is:

$$p = \frac{X+Y+Z}{\Sigma s} \qquad (1)$$

where Σs is the total number of students in the building.

n+2 Derivation

To find the actual per student cost per instructional period, the following equation is derived when:

A = actual salary for a particular classroom teacher for one hour of instruction (year)
B = cost of yearly supplies for one hour of instruction
Y = prorated local school costs
Z = prorated district costs
N = number of students assigned to a particular class period.

The equation is $$Pp = \frac{A+B+N+(Y+Z)}{N} \qquad (2)$$

where Pp is the per pupil cost per period.

Example:

A = teacher's salary ($17,000 per year) divided by the number of instructional periods (6):

$$A = \frac{\$17,000}{6} = \$2833.33$$

B = supplies for a particular math class: 30 expendable texts @$10 = $300; supplies = $600 (paper, chalk, calculators, etc.). Total = $900.
Y = prorated local school costs (Y=$41.26)
Z = prorated district costs (Z=$41.26)
N = number of students in one period of instruction (N=30)

Thus,

$$Pp = \frac{\$2833.33+\$900+30(\$82.52)}{30} = \$206.96 \qquad (3)$$

The cost of one student for one year in this teacher's math class is $206.96. Since math, compared to other courses, is a relatively inexpensive instructional program, we would assume that other courses might exceed this cost. It is also assumed that programs in the middle and elementary schools would cost less than secondary programs.

n + 1 Derivation

The next step is to cost moving a student through a class objective by objective.

Example: If a math course has ten objectives and the time for each objective is equal, it would cost \$20.70 to move one student through each objective. If Po is per pupil cost by objective:

$$Po = \frac{Pp}{\text{number of objectives}} \qquad Po = \frac{\$206.96}{10} = \$20.70 \tag{4}$$

r Derivation

The final derivation would consider the number of period (days) a student attends class in relation to his performance on a criterion reference test. Students who pass a criterion reference test may attend class from 0-180 periods. Those who fail one or more objectives and are required to repeat them must be included in the additive costs. Thus, the equation for finding the costs in terms of performance is:

Pc = per student cost of meeting an objective criterion reference for one class.
Nd = number of periods particular student is in attendance

$$\frac{Pc}{Po} = Nd \tag{5}$$

Po = per student cost based on attendance and criterion reference.

After one has arrived at the actual cost of moving a student through the program, the available data is usable for evaluating courses, programs, and district wide efforts.

This work flow costing process can easily be implemented by using a microcomputer with a 30mb hard disk using an integrated software program such as Enable. For full implementation it would be advisable to use a central minicomputer or a central office mainframe. The authors have pilot tested the formula on a microcomputer using Enable 2.0 a product of The Software Group. Two different methodologies were used: using the Enable spreadsheet program alone and using the Enable Database Management Program with the master control module to interact with a spreadsheet. Both procedures are satisfactory but the database management approach would be better if applied to a large school or school system or when criterion reference test data is collected. In the latter case students use a mark sense data sheet to record their answers or the test are a PC package. In either case the scoring, analysis, reporting and storage by individual, class and section is processed by the mainframe and an interactive data base.

A STUDY ON COMPUTER ASSISTED LEARNING AND TRAINING IN KOREA

Youngsoo Kim*

ABSTRACT

This study provides information on computer assisted learning(CAL) and computer based training(CBT) in Korea. Concerning CAL, the results of this study reveal the following: the curriculums for computer education in schools have not yet been established; the computer hardware, software and facilities for computer education are lacking as well as an insufficient number of professinally trained computer teachers. From the results of a survey conducted on 210 training centers of firms in Korea, it was found that only a small portion of training centers (15%) have applied the computer-based training(CBT) system while the rest of the firms only utilize computers for office automation. Lack of knowledge on CBT, CBT personnel, and administrator's support have been pointed out as the main reasons for not being able to use CBT system in training. In conclusion, the present CAL and CBT in Korea is still at an early stage of its development. It is expected that a nation-wide computer project begin in 1989 will promote the utilization of computers in educational institutions.

INTRODUCTION

To cope with the rapid change of today's information-oriented society, the Ministry of Education in Korea has been promoting computer education since 1983. Although computers were first introduced to the education scene in Korea in 1972, computers were applied mainly to the commercial high schools and not to the elementary, junior and senior high schools. Before a nation-wide computer education project be initiated by the Ministry of Education in 1989, the status and trends of computer assisted learning should be identified. This study discusses Korea's CAL in terms of curriculums, computer installment and software distributions, and in-service training programs.

The application of computers in the field of training, so called CBT, has been effective(ref 1). It is believed that industry and business firms in Korea can be improved further by the effective use of CBT. There is a very little research work done on CBT in Korea. Survey research on the present condition of CBT in Korean industrial institutions is almost non-existent. Therefore this study surveyed the application of CBT system in domestic industrial and vocational training centers in order to clarify the status of CBT and to make recommendations for its implementation in Korea's training centers.

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METHOD

Analysis of the present state of Korea's CAL was carried out by using the data from a survey conducted by the author on educational computer programs (ref 2) in 1986 and a survey conducted by the Ministry of Education in computer eudcation in 1988(ref 3). The subjects for the survey on computer programs were 263 teachers and 478 pupils of elementary and junior high schools in Seoul city. While all the elementary, junior and senior high and commercial high schools in Korea, a total of 10,597 schools, were involved in the survey on computer education.

The subjects for CBT study, 350 training centers of business firms and vocational training centers were randomly selcted from 2000 representative corporations throughout Korea. 210 training centers responded to questionnaires distributed in September, 1988. Construction of the questionnaire and interpretation of the responses were based on the study done by G. Kearsley (ref 4).

RESULTS

According to the outcome of the study on Korea's CAL, a total of 58,790 computers were being used in the 10,597 schools. The number of computers per school averaged 3.9 in elementary, 4.1 in junior high, 7.1 in senior high, and 24.1 in commercial high schools.

The utilization of educational computer softwares and coursewares in schools is in an extremly poor condition due to an insufficient quantity and quality of coursewares available in the market. In fact, only 6.1% of 263 teachers at 263 elementary and junior high schools in Seoul used educational computer programs. In most schools computers were mainly used for teaching computer manipulation and simple programing.

There are no computer related independent courses established in the elementary, junior and senior high schools. In the elementary schools, mostly students who belong to computer clubs have only an opportunity to learn the very basics of computer manipulation and simple programming through extra-curricular activity. In the junior high schools, very basic concepts on the computer's role in an information orientaed society were being introduced to only male strudents. Only in the senior high schools were computers taught in depth in what's called 'industrial technology course.'

In-service training programs for computer teachers began in 1974. Up to 1987, out of the total 288,743 elementary, junior and senior high school teachers, 49,346(17%) teachers were trained through in-service programs.

From the results of the CBT study, it was found that 31 training centers(15%) out of 210 used computers for training and computer managed instruction (CMI) was the most popular type of CBT. CBT personnel in general are moderately satisfied with their CBT system and recommend CBT system to other training centers. While the rest of the centers which were not adopting CBT used computers for mainly office automation and as the training media, booklets and slides were utilized. The main reasons for not using CBT was the lack of awareness on CBT(41.3%), lack of professional trainers(26.3%) and insufficient funds(23.5%). However, 56% of the institutions currently not using CBT have a plan to adopt CBT systems in the near future.

CONCLUSION

In general, although computer assisted learning and training in Korea is in progress it is not yet fully developed. However, in 1989, the Ministry of Education will initiate an ambitious computer project to facilitate computer application in schools. In the elementary and junior high schools, computer education will be offered through regular classroom hours and in the senior high schools, an independent computer course will be offered. It is expected that by 1996, the number of computers per school will be 31 and a total of 857 different kinds of educational computer couresewares will be developed by KEDI(Korea Education Development Institute) under the direction of the Ministry of Education.

It is recommended that in order to faciltate CBT, CBT Literacy education is urgently needed. CBT Literacy education shoud be carried out to cultivate CBT professionals and to promote CBT awareness to administrators and managers of training centers as well as to introduce and encourage the use of "systems approach" for designing and implementing CBT system in industrial training centers in Korea. In this way utilization of computers for learning and training will enhance the quality of education and training in Korea.

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CHALLENGES AND PROBLEMS RELATED TO THE INTRODUCTION OF MICROCOMPUTERS IN A BRAZILIAN PUBLIC SCHOOL

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ABSTRACT

This paper describes the introduction and the systematic use of microcomputers in a "High School" in Rio de Janeiro State, aiming at the effectiveness in the teaching of Biology, Physics, Mathematics, and Chemistry. The program was implemented in 1987, beginning with the 450 students of the first level classes. We expect that by 1989 we will have all 1000 students involved. As far as challenges and problems are concerned, special emphasis was placed on strategies for implementation, such as courseware design and development with the participation of the four subject matters teachers. This has been an attempt to provide adequate and up-to-date in service training. Challenges and problems are being overcoming and we can predict that the innovation will be permanently implemented at the school.

INTRODUCTION

The EDUCOM/UFRJ ia an interdisciplinary center for Educational Computing at the Federal University of Rio de Janeiro. Faculty members, researchers, technicians, and undergraduate and graduate students from different schools and colleges work jointly at the center.

The EDUCOM/UFRJ has been developing an experiment which comprises the introduction and systematic utilization of computer technology in a public system high school. The experiment aims at improving the teaching effectiveness of Biology, Physics, Mathematics and Chemistry.

In order to implement the experiment it was necessary to undertake several activities, such as facilities changes in the school setting and courseware design in the four content areas having the actual teachers as coauthors.

Four different research projects have been designed in order to monitor and evaluate the impact of microcomputers on students' achievement, educational practice, school administration, and human relations. One of these studies is being developed by the experiment coordinator.

The microcomputers were introduced to freshman students in 1987. In 1988, the experiment also included junior students and now will expand to include the senior classes. In this way, all students in the three year high school program will be involved with the experiment in 1989.

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The strategies adopted for planning and implementing the innovation were based on the diffusion-adoption of innovations literature . (ref 1)

PRELIMINARY STEPS FOR CONDUCTING THE EXPERIMENT

In early 1986, the University and the State of Rio de Janeiro Department of Education signed a cooperation agreement for developing the experiment.

The school selection was performed during the first semester of 1986. The Colégio Estadual Souza Aguiar (CESA)was selected among all 78 public high schools located in the municipality of Rio de Janeiro . The selection criteria definded by the EDUCOM researchers were the following: 1. the school should provide a standard curriculum rather than a vocational one ; 2. it should be classified as a "regular school" rather than as an "experimental" or a "model school"; 3. the school principal and teachers should be receptive and willing to participate in the experiment.

Other considerations concerned the amount of students in the school so that the resources would be available to all students in the same grade level; the school should have three regular high school program daily schedules (morning, afternoon, and night) as opposed to a single schedule (morning or night); it should be located within 20 km from the university campus in order to provide efficient equipment support and maintenance; it should also have space available to house the computer lab; it should be located in a safe building and have an appropriate electrical system to use the equipment.

The laboratory equipped with 22 microcomputers (8 bits), 22 drives, 22 color TV monitors (14"), and one 80 column printer was installed in early 1987. The State Department of Education gave the CESA administration permission to reduce from 60 to 30 (50%) the number of students in the classes. In this way it was possible to accommodate 2 studentes per system and still have 7 microcomputers as backups.

THE INTRODUCTION OF MICROCOMPUTERS AT CESA

The work with teachers who taugh the four disciplines in freshman classes began as soon as the school was selected . Since the introduction of computer technology was being imposed by the University and therefore it was a "top-down" decision process, special attention was given to persuade students , teachers, and other staff members to accept the innovation.

Teachers' active participation on curriculum planning and courseware design was the main strategy employed for implementing the innovation. (Ref 2,3)

Despite all difficulties in gathering with the teachers in a regular basis due to their busy classroom schedule, we were able to promote several meetings: some general meetings with all teachers involved with the experiment and other specific meetings with teachers from each discipline. These teachers immediatly began to participate in the design and development of the courseware that would be used.

In addition, a three day seminar was organized in early 1987. The goals of the seminar were to present the experiment philosophy and purposes, to discuss issues related to the field of educational computing, and present the courseware produced. After the first implementation year, the II EDUCOM seminar was already part of the school activities calendar for 1988. The teachers decided to plan and implement the next seminars along with the EDUCOM team.

Students were informed about the innovation in the beginning of the 1987 and 1988 school calendar. They were introduced to computers through the use of educational softwares.Plans are setup to continue with the same strategy, in 1989.

CHALLENGES AND PROBLEMS

An experiment supported by governmental funding should benefit the low income student population who has little access to microcomputer technology. The first challenge was the EDUCOM option to work with the public school system, that is, to introduce high technology resources in schools with the most basic problems and limitations which are peculiar to developing countries.

The second challenge relates to the size of the experiment . There are approximately one thousand students enrolled in the school program. Our goal is to have all student population using microcomputers in the four disciplines by 1989.

The third challenge relates to the process of getting teachers' participation. In order to cope with the lack of time,teachers in each discipline elected a representative to take part in the courseware production team. These educators were named as "linking teachers".

Finally, the fouth challenge has been to give teachers the conditions to integrate microcomputers in the teaching-learning process.

In addition to these challenges, the EDUCOM researchers have also been facing different types of problems: 1. The state government renewal led to an administrative reform in the State Department of Education and consequently to the school principal replacement; 2. Teachers' lack of knowledge about computers and their application in the educational process . This problem has been overcome through teachers'integration in curriculum planning and courseware development;3.Teachers' movement for better wages and improved working conditions endangered the continuity of the experiment: the school calendar missed 60 days of classes in 1987 and 90 days in 1988 due to teachers' strike. A regular school year has 180 days;4.Other operational problems relate with the use of micros as part of the daily routine and with technical difficulties.

CONCLUSIONS

The decision to implement computer technology at CESA was external to the school administration, teachers,and students. We are conscious that a "top-down" decision to innovate has considerably less chances to the successful than those who are teacher-initiated.

Nevertheless, the EDUCOM researchers have used a participant approach to introduce the innovation: giving the necessary support to the school members, counting on the principal's interest and receptivity, and giving the opportunity to the teachers to become involved with program planning and development.

The experiment has been successful despite all existent challenges and still present problems. The basic sciences teachers have expressed their interest in continuing to use microcomputers in the teaching of Biology, Physics , Mathematics, and Chemistry. The social sciences and the language teachers became aware of the innovation and are willing to introduce computer technology in their educational activities. The students have also expressed satisfaction in learning through the use of microcomputers.

This climate of acceptance allow us to predict that the innovation will be permanently incorporated to the school activities once the thre years experimental period is expired. The EDUCOM will continue giving the necessary support if requested.

The EDUCOM researchers have also been learning several lessons and improving their knowledge and skills to work in the field of Educational Computing.

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THE EDUCATIONAL SOFTWARE: AN ASSESSMENT SCALE

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ABSTRACT

"The Educational Software: an assessment scale" is a methodological study of descriptive nature which attempts to know the state of the assessment of the educational software and offer an instrument for its evaluation. So, after a deep study of the existing literature concerning this subject, it has been elaborated an assessment scale of the educational software which is divided into three parts:

A.- General characteristics of the software
B.- Technical characteristics of the software
C.- Educational aspects of the software

The scale and its items have been reviewed, modified and evaluated by ten teachers, all of them specialists in the use of computers in education; the first part, gobally and the other two, item,by item. So, it's attempted to explain why the scale has been elaborated with these characteristics and why the items have been included, pretending to detect other aspects which don't appear in the scale but wich would be suitable to include in.

INTRODUCTION

To choose the educational software which suits better our necessities is a task which, each day, is being more complicated due to the great variety of existing software and other reasons such as the development of educational software by publishers with or without the guidance of a technical-pedagogical team or the development of software made by teachers and/or amateurs in order to be used with their students.

It means that there's a great problem in the implementation and selection of software, as long as ther's an important offer but the guarantee of the product is rather unknown.

Researchers and specialists in the educational software set out as the firs and big step to stablish some basc criteria in order to elaborate and choose an educational software. Mosr researchers agree in many essential aspects in this topic but they aren't standardized.

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OUTLINE OF STUDY AND METHODS

Bearing in mind the checked literature and having as starting point the aspects which several authors consider of great importance in the implementation and selection of software, it has been elaborated a scale for its assessment.

The scale, as it was said in the abstract, consists of three parts, which have been considered as three "macrovariables". The values of each one are reflected in the corresponding items.

In order to make a first approach, validate the scale and give it reliability, it was followed this plan within each part:

1.- **Conceptualization of the macrovariables** where it's briefly explained the meaning of each one:

A.- **General characteristics of the software**: It's a first approach to the program through all this aspects which show a structured connection of informative nature.

B.- **Technical characteristics of the software**: Those aspects or technical requirements referred to the internal working of the program which influence in the student's learning in some way.

C.- **Educational aspects of the software**: Those characteristics which have to be considered in every educational process, such as objectives, contents, activities, evaluation, etc.

2.- **Educational justification**, where it has been attempted to clarify, from the educational point of view, the necessity of including these parts and their items in relation to the educational aspects.

A.- **General characteristics of the software**: The quality of the education depends on several factors, one of them is the multivariety of resources used in the curriculum development. Although it can seem a bit reduccionist, teachers have to know which are these means, in which concrete context will be better to use them, with which students and how they have to be introduced in the development of their activities. For this reason it's necessary the counseling of a specialist and a technical infrastructure which facilitate its knowledge, consultation and possible purchase. So, it's unquestionable the necessity of files of software, defined as **General characteristics of the software**, which let teachers have the basic information about each software, as it happens in a library.

B.- **Technical characteristics of the software**: Every educational action is determined by psychological and sociocultural factors which cause a specific reaction in the student. Consequently, from the educational point of view, these elements and its relations will be set in order to promote

the student's learning.
This part consists of these elements which can promote these process. So the items are referred to aspects such as motivation, feed-back, fatigue, functionality, control, etc., all of them very relevant in the development of an educational action by means of this strategy: the educational software.

C.- **Educational aspects of the software**: It's necessary that each teacher has some guidelines in the selection of the software when is programing, adapting the general basis to the specific context in which the software is going to be applicated.
In the selection of the software, it's important to consider its objectives, contents, activities and the assessment of all these aspects.

3.- **Algoritmic study about the specialists' opinion**. Through statistical analysis, it has been interpreted the specialists' opinion, comparing them whith our opinion, having as references the considerations from former sections and the theoretical background and "expertise". The objective is to verify the adequacy of each item to the judgement/assessment of the educational capacity of the software.
Whith regard to the data analysis and cleaning, there are some comments:

- Those items which weren't punctuated by some of the specialists received the punctuation of 5, which is the central value.
- In the interpretation of the basic statistics, 6 has been chosen as the reference measure in order to increase in one its statistical value.
- The punctuations have been defined as:

10, 9: Excellent
8, 7: Very good
6: Good
5: Acceptable
< 5: Insufficient

- Because of the small number of specialists (10), the interpretation of the basic statistics can be altered, so it has been centred in the distribution of frequencies.

RESULTS

This study is just an approach to the assessment of the educational software, and although it's difficult (or even impossible) to give a global vision, due to the small representativity of the sample, the scale seems to be interesting.

So, for each part, we can conclude the following points:

A.- **General characteristics of the software**: This part which consists of 18 items, was assessed globally, and all the specialists agree in its validation as a general vision of the existing educational software.

B.- **Technical characteristics of the software**: The analysis was item by item. Most of them were accepted but its relevance was differently considered. Following the specialists' comments, the structure of this part has been modified.

C.- **Educational aspects of the software**: The analysis shows a global assessment of the items which has been taking into account for the introduction or removal of some items.

The final structure of each part is showed in the Annex.

ANNEX

ASSESSMENT FORM OF EDUCATIONAL SOFTWARE

A.- TECHNICAL FORM OF THE SOFTWARE

1.- Title
2.- Author/s
3.- Publisher and distributor
4.- Date and place of publishing
5.- Price
6.- RAM memory required
7.- Drivers .... number
    Tape-recording .... number
8.- Software required:
    - Operating system .... version ....
    - Other software required
9.- Modality:
    - Drill and practice
    - Simulation
    - Educational game
    - Tutorial
    - Problem solving
    - Database
    - Other
10.- Use:
    - Individual
    - Small group
    - Clasroom
    - Remedial
    - Ruled teaching
    - Improvement
    - Special education
11.- Content Area:
    - Mathematics
    - Social Sciences
    - Technology
    - Language Arts
    - Experimental Sciences
    - Foreing Languages
    - Other
12.- Level:
    - Pre-school
    - Primary
    - Lower Secondary
    - Secondary Education
    - vocational Education
    - Entrance in University Course
    - Special Education
    - Adult Education
13.- Documentation:
    - Teacher's guide
    - Student's guide
    - User's handbook
    - Technical information of the software

B.- TECHNICAL CHARACTERISTICS OF THE SOFTWARE

1.- EASY FRIENDLY

1.1.- Help
1.2.- Control of the development of the program
1.3.- Control of the level of difficulty
1.4.- Possibility of going back to the previous informations
1.5.- Possibility to quit without finishing the program
1.6.- Demos
1.7.- Capacity to handing student's possible mistakes
1.8.- Possibility of being modified/adapted to user's needs
1.9.- Possibility to use the program with a minimun knowledge about Computer Science
1.10.- Utilization of the program without consulting hanbooks
1.11.- Easiness to loading the program

2.- TECHNICAL DOCUMENTATION

2.1.- Specification of the necessary requirements to run the program
2.2.- Instructions to run the program
2.3.- Explanation of the different options
2.4.- Graphic examples in the screen
2.5.- Index of the contents of the program
2.6.- Directions to modify the program

3.- EDUCATIONAL DOCUMENTATION

3.1.- Contribution of the progam to the traditional educational methods
3.2.- Specification of objectives
3.3.- Teacher's guide
3.4.- Student guide
3.5.- Student worksheet
3.6.- Suggestions for the integration of the activity in the classroom
3.7.- Other materials for the program
3.8.- Suggestions for its application and development
3.9.- Suggestions for previous and later activities
3.10.- Literature and references

4.- SCREEN PRESENTATION

4.1.- Use of graphics and animation
4.2.- Use of colour
4.3.- Use of sound
4.4.- Clarity of messages in the screen (menu, ...)

5.- GENERAL COMMENTS

C.- EDUCATIONAL ASPECTS OF THE SOFTWARE

1.- OBJECTIVES

1.1.- Defined at the beginning of the educational sequence
1.2.- Adapted to the curriculum
1.3.- Objectives of different categories included
1.4.- According to the teaching-learning process
1.5.- Their semantic content alludes to the learning process
1.6.- They are within reach
1.7.- Precise formulation
1.8.- Student activity clearly indicated

2.- CONTENTS

2.1.- Suitable to the objectives
2.2.- Up to date
2.3.- Vocabulary and grammar suitable to the educational level
2.4.- Information complete as to be undertood
2.5.- With logical sequence
2.6.- Organization facilitates transfer

3.- ACTIVITIES

3.1.- Related to the objectives and contents
3.2.- With logical sequence
3.3.- Create and support predispositions for learning
3.4.- Facilitate the creativity and transfer
3.5.- Foresee connections with the cultural world of the student

4.- ASSESSMENT

4.1.- Related to the objectives, contents and activities
4.2.- Collection and showing of results to the student
4.3.- Guidance of student in the correction
4.4.- Possibility to access the evaluation easily for the teacher
4.5.- Comparison among the students' results

5.- GLOBAL EVALUATION OF THE PROGRAM

- It can be selected
- It's doubtful
- It can't be selected

DEVELOPMENT OF INFORMATION TECHNOLOGY EDUCATION: THE HONG KONG SCENARIO

Douglas S. Tung*

ABSTRACT

Information Technology (IT) is a diffuse and rapidly developing discipline, and it is an interdisciplinary subject. This paper reviews the development of information technology education in Hong Kong. In an application-oriented and developing country, like Hong Kong, information technology courses at first permeated into the computer science curricula of the tertiary institutes because of their usefulness. Later, IT evolved into a new academic discipline. In view of the its strategic value to prepare people to take up new jobs, developing countries should also consider national IT plans.

INTRODUCTION

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has defined Information Technology (IT) as "the scientific, technological and engineering disciplines and the management techniques used in information handling and processing; their applications, computers and their interaction with men and machines; and associated social, economic and cultural matters". That is, Information Technology embraces the application of computing, communication and associated office technologies to the capture, storage, retrieval, processing and dissemination of information. Thus, it is a diffuse and an interdisciplinary subject.

Historically, all the developed countries of the world have experienced a shift in the profile of the working population towards information-related jobs. In the 1980's and in these countries, more people, called the knowledge workers, have been engaged in the handling of information than in producing food, manufacturing goods or providing services. In general, it is realized that businesses or nations who do not make maximum use of the information technology will suffer in creativity and productivity and cannot hope to compete economically.

In Hong Kong, the major application areas of information technology, namely the financial, trading and manufacturing have for a long time made up the very fabric of its economy. It is because of the availability of the information technology infrastructure that Hong Kong has become the third largest financial center, shipping center and manufacturing center of consumer electronics etc. in the world. The need to plan an educational response to prepare knowledge workers for an information technology application-oriented community has made some impact on the curricula of the close cousins of information technology, namely computer science, electrical and electronic engineering.

IMPACT ON COMPUTER SCIENCE CURRICULA

Undergraduate computer science and information systems education in Hong

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Kong have been written with reference to the ACM Curricula Recommendations (refs. 2 and 3). A review of the core courses in Curriculum '78 indicates that there are eight core courses (fig. 1) and ten advanced level elective courses (fig. 2). Berztiss took the view that the Curriculum tended to emphasize the vocational aspects of computing (ref. 4). Due to the differences in resources and requirements of engineering schools on one hand and the liberal arts schools on the other, there was the trend towards multiple curricula. Though this trend may not be in the best interests of computer science, per se, yet it provides more flexibility to the institutes which would like to emphasize on the application aspects of computer science.

CS1. Computer Programming I
CS2. Computer Programming II
CS3. Introduction to Computer Systems
CS4. Introduction to Computer Organization
CS5. Introduction to File Processing
CS6. Operating Systems and Computer Architecture I
CS7. Data Structures and Algorithm Analysis
CS8. Organization of Programming Languages

Fig. 1 Core of Curriculum '78

CS9. Computer and Society
CS10. Operating Systems and Computer Architecture II
CS11. Database Management Systems Design
CS12. Artificial Intelligence
CS13. Algorithms
CS14. Software Design and Development
CS15. Theory of Programming Languages
CS16. Automata, Computability, and Formal Languages
CS17. Numerical Mathematics: Analysis
CS18. Numerical Mathematics: Linear Algebra

Fig. 2 Elective Courses for Curriculum '78

With reference to UNESCO's definition of Information Technology, some of the courses in Curriculum '78 were viewed as having strong favour of information technology. They are: CS5. Introduction to File Processing, CS9. Computer and Society, CS11. Database Management Systems Design, CS13. Artificial Intelligence and CS14. Software Design and Development.

Since the economy of Hong Kong relies very much on the information technology, there is a need to incorporate information technology courses into the curricula. A study of the computer/computing science/studies of two universities and two polytechnics showed that since 1984 the courses with strong information technology favour mentioned above have permeated into the curricula of these institutes. In addition, there are other information technology courses present in one or more curricula of the Hong Kong's tertiary institutes. The author is aware that by presenting the titles of the courses only, they cannot describe the nature of these courses. However, the clarity is sacrificed due to the limitation on the length of the paper. They are:

1. Information
2. Modelling and Simulation
3. Computer Graphics and Computer Aided Design

4. Distributed Processing and Networks
5. Software Engineering
6. Commercial Applications of Information Technology
7. Media Applications of Information Technology

IT AS AN ACADEMIC DISCIPLINE

Though the term IT is around, yet for IT to be recognised as an academic discipline, there must be a distinct body of knowledge which one has to acquire in order to function effectively in a particular line of work. However, due to the rapid change of technology and the wide diversity of applications, it is difficult to agree on the complete content of such a body of knowledge. Therefore, some kind of conceptual framework which places such knowledge on a systematic and rigorous footing must be available, so that despite changes in the details of the subject matter over time or changes due to technological advancements, the unity of the discipline as a whole is not affected (ref. 5).

There are two broad directions in which IT can possibly develope into an academic discipline. IT can evolve into an umbrella term covering all of Computer Science, Information Systems, Data Communications, Microelectronics and Man-machine Interfaces, having an engineering orientation. In this context, it has many overlapping interests from a number of professions, and it cuts across discipline divisions in academic institutes. There can be many cooperative programmes on IT between departments of Computer Science, Engineering and Business, but no single department focuses all IT work. On the other hand, IT may become more narrowly confined to the study of the fundamental techniques and methodologies of information transfer, regardless of the information processing entities and specific circumstances. In such context, the study can develop into a coherent body of knowledge which is sufficiently distinct to form a new academic discipline. However, most IT proponents are in favour of the first direction for its rich contents.

In 1985, a Working Party to plan and to co-ordinate developments of the IT Programme was established in the City Polytechnic of Hong Kong. A three year BSc Degree Course on Information Technology was implemented in 1986. The course comprises an integration of the studies of electronics and computing. In order to provide laboratory facilities for these courses, the following resources centers were established.

(1) The Business Automation Center provides facilities for the study of modern business automation methods. It consists of equipment, software and fittings which are flexible enough to be arranged into different configurations, representing a variety of applications. The facilities include microcomputers with hard-disks, work stations, data communications, facsimiles, teletex, videotext and appropriate furniture.

(2) The CAD/CAM Center provides Computer Aided Design work stations, plotters, digitizers and other ancillary equipment. Microcomputer based systems, as well as those running on larger machines are available. Software includes two dimensional drafting, three dimensional modelling and finite element analysis.

The Working Party also recommended all students in the Polytechnic should be given the opportunity to acquire basic information technology skills by offering them courses in Word Processing, Spreadsheet and Database. Some of these courses are taught with the use of CAI packages.

In the fall 1988, the Chinese University of Hong Kong launched a BSc Degree Programme in Information Technology. It is an integration of the studies of computer science, electronic and management.

A NATIONAL IT PLAN IS CRUCIAL

Since early 1980's, a world-wide interests in information technology development have been astounding. The Japanese "Fifth Generation Project" launched in 1981 triggered the formation of the British "Alvey" Programme, the European "ESPRIT" Programme and the respective American, French, German and East-European state and industry sponsored initiatives. Technologically aggressive countries have seized this opportunity, while others, more complacent, will end up playing the difficult and expensive game of trying to catch up.

At this moment, Hong Kong is going through a transitional phase in which information technology will play an increasing role. Hong Kong's position as a financial centre and international trade market requires the support of its high-quality information processing capabilities. It is against this background that information technology programmes are offered in our tertiary institutes. In the future, Hong Kong is likely to remain as a user of high technology, rather than a producer or creator, and many developing countries are similar in this aspect.

The author advocates that even for developing countries, such as those in the Pacific Basin, their governments should play a leading role in the formulation of Information Technology polices to facilitate the transfer of Information Technology. The transfer of established technologies must also be complemented by the development of local experts and experiences in building information products. In view of the limited resources available in the development countries, R & D objectives and directions should be carefully selected, coordinated and regularly reviewed. The assimilation or final transfer of technologies require a partnership between the industry and the academia with governmental support. Sharing the experiences from other developing countries and the idea of complementary development are possible, because information technology is portable; and that they are necessary because information technology is so important in the coming decade.

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WORD PROCESSING AND THE DEVELOPMENT OF WRITING SKILLS OF PRE-SERVICE EDUCATION STUDENTS

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ABSTRACT

In Australia, as in U.S.A., there has been a call to "Go Back to the Basics". The claimed inadequate writing and spelling skills of teachers are usually blamed for the current crisis. Frequently, university teachers lay the blame at the door of secondary teachers, who in turn blame elementary teachers. Thus the cycle viciously spirals. This paper examines an approach used at Deakin University for using word processors with freshman students as a method of addressing the problem of poor levels of writing skills and also low levels of computer literacy.

INTRODUCTION

Like many other Australian and American tertiary institutions Deakin's School of Education has to face the continued problem of enrolling students who have less than adequate basic literacy skills. It is not the purpose of this paper to add to the tirade directed in all directions in an effort to apportion blame for these inadequacies or to "pass the buck" with tertiary teachers blaming secondary teachers, who in turn blame elementary teachers. Instead it is critical that we recognize that we have a problem and formulate effective methods of breaking this apparently self perpetuating cycle of incompetence.

One common "solution" to the problem of perceived inadequate literacy levels is to mandate compulsory "literacy" courses for all freshman students. This approach has been adopted by the School of Education and students are only able to progress to later years of the program once they have passed a mastery test in the units "English Competency" and "Mathematics Competency". This approach has the advantage that it is highly visible and the School is seen to be doing something. However, the "tacked on" nature, coupled with the pejorative, remedial aspect of these mastery programs, can cause students to feel little or no control over, nor ownership of, their own learning. The focus is on the mastery test, with little or no real emphasis on individual student deep-level deficiencies accrued idiosyncratically over many years. Such "Competency" courses epitomize what Friere (ref 1) has labeled "Banking Education", in which the teacher "deposits" knowledge into the supposedly empty head of the student.

Since 1985 the "English Competency" course has included a section in which students are expected to acquire a functional level of skill using a word processor. Traditionally elementary school teachers have seen themselves as "non-technical" and thus neither able to learn nor interested in learning to use computers. Faculty responsible for the Educational Computing Laboratory (ECL) argue that only by making word processing a basic, rather than a specialized, skill will student teachers move into the "computer culture" of the future.

There have been many improvements in the way which word processing has been presented in the competency course and this paper reports one such development - collaborative work between faculty in the "Teaching Studies" and the "English Competency" courses. It is important to emphasize that these developments are not simply ad hoc changes but rather are based on our beliefs about learning and reflections on previous practices.

We believe that students should be encouraged to be actively in control of, and responsible for, their own learning. Students need to own and control what it is they are learning if they are to make those learnings understandable and meaningful to themselves. While this is true

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at other educational levels it is even more important when working with adult learners.

We also believe that learning should be "contextualized" in at least two senses. Firstly student learning should be based on their current work - solving real problems rather than learning something because "it will be useful in 3 or 4 years time". Thus learning to use a word processor on a user-needs basis while preparing a paper is preferable to direct instruction in a faculty-controlled curriculum. The second sense of context is that learning should occur within a social context. This does not mean only artificial teacher generated pairing of students but also informal task-oriented groupings of students from different years and even students and faculty. Papert (ref 2) has used the image of a "samba school" to encapsulate this idea.

Student teachers are in the curious position of learning about learning and also being taught about teaching. If we can capitalize on this duality and encourage our students to be conscious of themselves as active and autonomous learners then they will be in a much better position to support their own students in the future.

In addition to the overt agenda of improving students' literacy skills while helping them to become aware of computers we are also providing our students with first hand experience of an educational model which exemplifies good sound educational principles. In other words we want them not only to practise what we preach but also practise what we practise.

The ECL faculty and the School espouse the process of reflecting on practice, linking practice to theory, and from there initiating change and improvement. The remainder of this paper describes our experiences in 1987 and 1988.

1987

In 1987 all Teaching Studies students were expected to use a word processor to prepare a one page paper entitled "The Teacher I Want to Become".

We limited the task to a one page ungraded task because we knew that the majority of our students would be nervous when faced with the requirement that they use the word processor to prepare the paper. We were also aware that some students would not use the editing features of the word processor but would use it as a "glorified type writer" to produce the final copy of their paper. Thus we used two strategies to legitimize the process of preparing a draft which would be edited before printing the final copy. Firstly, we required each student to ask one of their peers to review and make comments on their paper. Secondly, the tutors were required to work according to the process approach (ref 3) and make critical but supportive comments on the paper and return these to the student before the final draft of the paper was submitted.

While the requirement to use the word processor to prepare the paper did have a positive effect on both the students' writing and word processing skills there were also several difficulties. Firstly, some students interpreted the small (one page), ungraded, hurdle nature of the paper to mean that the task, and also word processing, was trivial and unimportant. This impression was confirmed by the "one off" nature of the task; it was not required that any other papers would be word processed and some students refused to work in the ECL once the exercise was completed. Thus, for some, the task was reduced to another example of "Banking Education" being forced upon them and indeed, we may have turned the ECL into an aversive environment for some.

Another problem stemmed from the fact that not all tutors understood both the rational for, and mechanics of, requiring that the papers be prepared and edited using a word processor. Some tutors were not aware of the relative ease of editing using a word processor, compared to pen and paper, and felt that by demanding major changes and insisting on high quality writing they would simply be imposing more unnecessary drudgery on already hard pressed students. Thus, by not requiring the student to edit and resubmit sub-standard work these tutors were unknowingly undermining the purpose of the task.

A further difficulty related to the contrast between the previous educational experience of our students and the educational context of the ECL. The vast majority of freshmen students have come directly from secondary schools where the dominant educational model has been that of the teacher actively "teaching" and them passively "learning" by following set educational tasks. In contrast, in the ECL, the emphasis was placed on the students being active and autonomous learners and referring to printed "Help Notes", student assistants or their co-learners when they needed assistance. While faculty in the ECL maintain that this is an appropriate educational environment it is imperative that we are aware of the mismatch between the students' previous educational experiences and the educational environment of the ECL.

1988

In 1988 in an attempt to increase the perceived importance of the use of the word processor by students the Teaching Studies team required all student papers to be prepared using a word processor (students could use a home computer if they found this more convenient). The length of papers was restricted to encourage the development of good, clear, succinct written expression; the lengths of the first two papers (1 and 5 pages) were to be adhered to and sent back for re-submission if they were longer (this is a practice used successfully elsewhere, ref 4). All papers had to have correct spelling, punctuation, grammar, etc. before they could be graded. When resubmitting a paper students were to submit all previous drafts. All papers were graded on a 5 point scale. The topics of papers were a direct reflection of the School's policy to deliberately take an exploratory practice-based approach to teacher development in which theory and practice are directly linked. The emphasis in all papers was on the student's own perception of his or her personal growth and development as a teacher and the actions he or she took to link theory to practice.

The tutors also needed to have a greater involvement in, and understanding of, the operation of this program. The first action that had to be taken was to develop tutor experiences with the word processor which most students were to use. The Teaching Studies chairperson (Ferguson) and one of the ECL faculty (Evans) prepared a poorly written "sample student paper" which was then presented to tutors to edit as severely as they wished. Interestingly, the tutors were resistant to do much more than superficial editorial work on the paper. The tutors were then shown how easily the paper could be edited using the word processor. The alterations involved use of a spelling checker, removal of redundant words and phrases, cutting and pasting to make the paper more logical, the correction of punctuation, and doing a final word count. The word processor naive tutors were impressed by the ease of these operations and agreed that this made a difference to their perceptions of the amount of editing they could expect students to do when using the word processor.

The other major change at the faculty level was to modify the students' induction into the ECL. Relative to 1987 the student assistants (Neddies) took a higher profile role in teaching the groups of freshman by planning and demonstrating specific aspects of the ECL and the computers. Neddies based the sessions on their own naive attempts to come to grips with the system in 1987 as freshmen. A major point continually stressed was that everyone can help someone else, the philosophy being that you repay the help you have been given by helping someone else in the future. A second point was that everyone is capable of learning to use the word processor to the level which is appropriate or useful for them. The powerful experience of using the recently computer naive (rather than experienced experts) to teach and help the beginners in the first few weeks was most successful because the neddies were more aware of the likely problems the beginners were having and were able to erect more appropriate mental scaffolds for them.

All tutors reported heavy editing of the first papers; all stated that every student had to do more than one draft before producing a satisfactory paper. Many students complained about the task of condensing their thoughts into one page, but were eventually successful. In later papers some tutors were less stringent in applying this constraint. All tutors reported by the end of the year that their students were generally attaining a higher than usual level of competence in their writing, although there was still much progress we need to achieve. The ECL faculty reported that there seemed to be a higher acceptance rate of word processing and a higher rate of ECL usage by first year students in 1988 than in previous years.

CONCLUSIONS

The requirement to use a word processor to prepare papers in the Teaching Studies course provided an effective focus for students to become more responsible for their own learning. Most importantly, students learnt not only about writing and about computers, but also about the very act of learning and teaching.

The program would be much more successful if all tutors could be convinced to use the computer themselves, for although they now see some of the values, they will only become fully aware of the real strengths and range of operations of a word processor once they begin to use one themselves. Three of the tutors have made efforts to learn how to use a computer during 1988 and there remain only two tutors (who did not attend the familiarization session) who seem unable to push their students into making maximum use of the computer. In 1989 the chairperson will distribute this paper to all tutors in an effort to strengthen their commitment to word processing within the Teaching Studies course.

It is clear that both tutors and students must be aware of the process approach to writing. Only with this awareness will tutors and students become comfortable with the idea of working collaboratively on improving written work. Interestingly, the tutors seem to have less trouble sticking to the expectations set by the course team when working on short papers; on the longer papers they seemed to drift into allowing students to slip back into less effective writing habits. Perhaps this reflects the fact that the tutors are not fully aware of the ease of editing a paper on a word processor, or perhaps they are reluctant to require the work to be resubmitted if the student has apparently spent a large amount of time on the paper.

The role of critical friend, by tutor and peer, in responding to student writing must be more vigorously fostered. It must be made explicit that all teachers must be responsible for their own actions as well as being responsible for guiding their students into taking control of and being accountable for their own learning, and the aim must be for the best quality possible from every learner. In addition, the team needs to reintroduce the 1987 notion of peer review. The original purpose was fourfold: to provide some critical commentary on the substance of the paper; to help the peer learn about the evaluation of written products; to introduce the peer to the process approach to teaching writing; and to reinforce another practice in the course, that of pairing students in the classroom practicum for the explicit purposes of peer review and support.

The ECL faculty and Neddies are also working on ways of building better and more appropriate mental scaffolds to give students greater flexibility in taking control of their own learning of the computer system operating in the ECL.

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AN A.S.T.U.T.E. APPROACH TO FACULTY DEVELOPMENT

C. Blurton*

ABSTRACT

Faced with a state-legislated mandate that candidates for a clear (i.e. permanent) California teaching credential have coursework including computer skills and knowledge, concerned California State University (CSU) teacher education faculty formed a professional organization, the Association of State Technology-Using Teacher Educators (ASTUTE), to help meet this new requirement. ASTUTE has provided an important new vehicle by which teacher education faculty can share information, obtain training, and interact with other faculty across the 19 CSU campuses.

BACKGROUND

In 1985, California Assemblyman Sam Farr introduced legislation (AB1681), subsequently passed by the legislature and signed into law by the Governor, which specifies that "the minimum requirements for a clear teaching credential shall also include satisfactory completion of computer education coursework which includes general and specialized skills in the use of computers in educational settings ...." The California Commission on Teacher Credentialing (CTC) was directed, as part of the legislation, to develop Title 5 Education Code regulations delineating the general and specialized skills. The new regulations were to be implemented as of July 1, 1988.

The CTC empaneled a broadly representative group of educators, technologists, and members from business and industry to write the Title 5 regulations. This group, working over a period of months, developed a list of competencies to be included within the specified coursework and an Implementation Handbook to provide guidance to the state's more than 70 teacher preparation programs as they sought to develop a plan to meet the new requirement. This CTC Computer Education Advisory Committee broadly interpreted the language of the bill to include "computer-based technology ... such as telecommunications, interactive video and compact disks."

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THE CALIFORNIA STATE UNIVERSITY SYSTEM

AB1681 was of particular consequence to the California State University system, as the CSU at its 19 campuses across the state annually prepares more teachers than any other institution in America--approximately 10% of the total nationally and 70% of California's teachers. As is the case at most teacher preparation programs within California and elsewhere, most CSU faculty with responsibility for preparing preservice teachers have little experience using technology for instructional purposes. This is not surprising when one considers that the average age of a CSU faculty is approximately 50, with most having entered the university prior to the influx of technology into public K-12 classrooms. Compounding the problem of a lack of faculty expertise was a lack of faculty workstations and, on many campuses, inadequate computer laboratory facilities for preservice student use. AB1681 did not provide funding to teacher preparation programs to meet the new requirement.

T.I.T.E. CONFERENCES

With the passage of AB1681, faculty who were teaching computer education courses from several CSU campuses began informal discussions about the new requirement and how it would impact their campus programs. Consensus was quickly reached that most of the CSU teacher preparation programs, without further guidance, would respond to the new legislation by developing a single computer course that would be required of all preservice teachers. This was not considered to be an optimal solution by either the CTC Computer Education Advisory Panel or many of the faculty teaching computer courses for Schools of Education. A more appropriate outcome would be some combination of specialized coursework and the infusion of technology skills within existing methodology courses. This integrated approach would provide teacher candidates with the opportunity to see technology use modeled appropriately within their own courses by content experts.

To foster the development of campus plans that included some integration of technology into existing teacher education coursework, and to provide a forum at which teacher education faculty could learn about and discuss the new regulations, a few interested faculty, making use of residual funding from an inservice technology training program, organized and offered two "Technology In Teacher Education (TITE)" conferences in the spring of 1987 for faculty and administrators from each of the 19 CSU campuses. These conferences, one held as CSU San Bernardino for the nine southernmost CSU campuses and the other at CSU Sacramento for the ten northernmost CSU campuses, were attending by more than 150 teacher preparation program faculty and administrators. During these two day conferences, information was provided concerning the new regulations, opportunities were provided to discuss their implications, and campuses were given the opportunity to begin planning to implement the legislation. Volunteers were also identified to begin the process of establishing a permanent faculty organization to continue the dialogue begun at the TITE conferences.

A.S.T.U.T.E.

An organizational meeting was held following the TITE conferences at CSU Fresno during which bylaws were drafted and a name selected for the new organization (the Association of State Technology-Using Teacher Educators). The organization has an executive committee comprised of 19 representatives--one per campus--appointed by the Dean of the School of Education, a chair elected from within this group, and various standing committees to conduct the business of the group. Although AB1681 was the catalyst for the formation of the group, it undertook a broader charge: "to promote appropriate uses of computer-based technologies to include but not limited to microcomputers, videotape, satellite teleconferencing, and interactive videodisc in preservice and inservice teacher preparation and k-12 instruction."

The ASTUTE executive committee meets twice annually, once in southern California and once in northern California, in conjunction with the Computer Using Educators conferences. During these meetings the agenda typically ranges widely with the committee considering requests for cooperative research, discussing software licencing opportunities, sharing possible funding sources, and other pertinent information. In the spring, 1988, the ASTUTE Council planned and conducted a five-day faculty workshop for instructors of elementary language arts and social science/history methodology courses. Attended by 25 faculty from 15 of the 19 campuses, the workshop provided participants with information about AB1681, a curriculum "module" developed by faculty experienced in the uses of technology in the two disciplines (only some of whom were members of the ASTUTE Council, one individual was a faculty member from a University of California campus), and software and a videodisc that these instructors could return to their campuses with and use in their courses. Funding for the workshop was provided by a grant from the CSU and from the State Department of Education. The workshop, including curriculum development, instructors' fees, materials, and room and board for the participants and faculty, cost approximately $38,000 with the bulk of the money being spent on hotel and meal expenses. Each campus paid for the transportation expenses of its participants.

Participants, upon arriving at CSU Fresno where the workshop was held, were surveyed to establish--by self-report--their present level of technology usage within methodology courses. At the end of the workshop, each was asked to complete an evaluation. This information was reported to the funding agencies and has subsequently influenced planning by the ASTUTE Council for other events. It is of interest that fully one-half of the participants, in the initial survey, indicated that they currently modeled the use of computer-assisted instruction in their methodology courses. One-third responded that they modeled the use of instructional television/ video tape. On the summative evaluation distributed on the last day of the workshop, participants were asked to respond to the statement: "The information I acquired at the ASTUTE workshop will assist me to train my students to use technology in their classrooms." On a five-point scale ranging from strongly agree (5) to strongly disagree (1), the average response was 4.75 indicating a strong positive impression of the faculty development activity by the participants.

In conjunction with the faculty development workshop, almost all of the ASTUTE Executive Council members attended the last two days of the workshop for two purposes. First, to receive telecommunications training, software, and a modem and second, to meet with their campus participants to discuss next steps for implementing the training within methodology coursework. As a result of this training, a computer conferencing and electronic mail capability for the organization now exists, although it is presently under-utilized.

During the 1988-89 academic year, ASTUTE will conduct two 3-day faculty development workshops focused on the use of technology within elementary mathematics and science instruction and a single 3-day workshop focused on interactive videodisc. The latter is of particular note because the basis of the curriculum will be a videodisc and supplemental instructional materials developed specifically for CSU teacher preparation programs by three ASTUTE members. As has been true for all of the ASTUTE workshops, the 1988-89 workshops will be held at different campuses. The first math/science workshop will be held at CSU Los Angeles, the second at CSU Hayward, and the videodisc workshop will be held at Cal Poly San Luis Obispo.

SUMMARY

The key points that make ASTUTE unique in California are that it is a "grass roots" technology organization created by teacher preparation program faculty for teacher preparation program faculty in response to a legislated technology mandate and that it is the first such organization within education as a discipline that has brought together representatives from all of the 19 campuses to cooperatively plan faculty development activities. The organizational structure, an executive council with an elected chair, has worked well to maintain the flow of information to all of the campuses and to conduct the business of the group. Overall, ASTUTE has made and continues to make an important contribution to the uses of technology within teacher education programs in California.

DEVELOPING AND IMPLEMENTING AN IT POLICY IN A UNIVERSITY DIVISION OF EDUCATION INITIAL TEACHER TRAINING COURSE

C. T. Opie

ABSTRACT

Views as to what form Information Technology (IT) should take in the curriculum of schools follows two main trains of thought. One regards IT as a subject deserving of specialized study, the other that it should be an element of all existing traditional subjects. However irrespective of which train of thought one supports IT will only achieve successful implementation if those charged with such a role feel confident in its use, appreciate its educational benefits and are prepared to accept the consequent changes in teaching styles that its introduction brings. The view taken at Sheffield University's Division of Education is that its initial teacher training course (ITT) should incorporate IT as an element of its existing ITT method courses. This paper outlines the reasoning behind this decision and how the ITT course has implemented its IT policy over the last three years. Details of how it has financed its IT policy will be in the presentation.

WHY A CROSS CURRICULAR APPROACH?

Problems inherent with establishing specialised IT courses in schools are documented (Ref 1). They included:

1. Staff not directly involved with IT may feel no need to bother with it since it is being "done" elsewhere.

2. Delegation of such a course to one subject might lead to a narrowing of what is undertaken.

3. IT could come to be regarded as just one more subject and as such its pervasive nature could be in danger of becoming lost.

4. A definitive course might lead to ossification in what was, (and still is), in reality an area of rapid change.

However not all views (Ref 2) deprecated the existance of specialized IT courses and there continuance was likely to remain for the forseeable future.

The alternative approach, that of integrating IT within existing traditional subjects implied that each subject area

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of the core curriculum considered how it might change to meet the implications of IT and then adapt accordingly. Such an approach had its attractions in that it viewed IT as a resource, to be called upon where appropriate and it also had a greater chance of harnessing the diverse strengths of staff as a whole.

After discussion agreement was reached that the Divison should work to a policy of incorporating IT as an element within all its existing ITT method courses and that where it occurred it:

1. Bore relevance for students and their work with pupils and schools.
2. Be supported with discussions of the educational advantages that it had to offer and the changes in teaching styles that its use brought with it.
3. Should receive regular review and be flexible enough to incorporate new initiatives as they arose.
4. Should seek to capatilise on all external sources of support.
5. Implementation should be (as far as possible) by method tutors in the normal course of their work.

IN THE BEGINNING ...

Not all method tutors were convinced of the value of introducing elements of IT within their ITT course. This being the case IT work was carried out almost exclusively by the "IT Specialist". This was not in keeping with original objectives but seemed (as it has since proved) a necessary departure. In fact rather than make any move to encourage unconvinced staff to gain further experience of IT it was preferred to let them observe the effects that it had on their students and judge the benefits or otherwise from this. All tutors were however invited to courses and were continually consulted on all aspects pertaining to their subject area in order to ensure the relevance of the IT contribution.

Students were given every opportunity to use IT with the main thrust being on word processing (WP). Relevance of WP to students coursework e.g. assignments, lesson plans, worksheets and project reports was self evident. In keeping with other IT objectives students were also given the opportunity to discuss the educational advantages of WP's after observing and talkig to pupils using them.

Over the year many additional one off activites involving IT were carried out and overall the year proved successful and laid solid foundations for future development.

IN ITS SECOND YEAR ...

The approach in the first year with unconvinced method tutors paid dividends. Not only did the IT courses of the previous year continue to flourish and grow but requests from method tutors, a number previously uncertain as to its benefits, for further IT input was forthcoming. As a result work with database, spreadsheet and desk top publishing packages were incorporated into method coursework with care taken that whatever was done continued to be relevant to the students needs and those of his or her method work.

Two notable developments over his year were the purchase of an interactive video system so that students could begin to explore the educational value of this medium and the development of software, in partnership with local teachers, to encourage science teachers to experimnet with computer monitoring in their classes (Ref 3). Both these developemnts only added support to the pervasive and continually developing nature of IT.

Also over the year those few remaining method tutors doubtful of the value of IT became convinced of its potential and in addition a number of other method tutors started to incorporate IT as part of their course content themselves!

THE COURSE A YEAR AGO ...

With all ITT method staff convinced of the value of IT and in a number of cases prepared to take IT issues on board themselves little effort in terms of IT course development occurred with most of the time spent solely in consolidation of what had previously taken place. However so successful had been the implementation of IT that demand had grown from method tutors to have IT facilities within their own rooms. It was clear that this request required meeting if the Division was to ensure continued IT development.

Considerable time was spent in preparing proposals to place the existing microcomputer systems into method tutors rooms and re-equip the Division's IT Centre with new equipment. It was pleasing to find these proposals enthusiastically received.

AND NOW ...

Method tutors have their own IT facilities and this personal ownership has not only resulted in even more IT work being implemented but more significantly more being implemented by the method tutors themselves. Foreign language word processing and greater use of desk top publishing packages being two examples.

At the request of a few method tutors and under the guidance of the "IT specialist" a satellite system has been purchased and ITT students are assessing the potential of real time remote sensing as a classroom activity. Further interactive video discs have been acquired and are being used by the ITT students in their teaching practice schools. One group of ITT students have actually initiated the settiong up of a Local Education Authority's interactive video system in a school and instructed the staff how it could be used.

So, after three years the objectives for the Divison's IT work seem to be being met.

WHAT OF THE FUTURE ...

The UK education system is undergoing major changes not the least of which is the implementation this September of National Curriculm. How IT fits into this is still uncertain although initial views that,

> 'the use of information technology can be taught through other subjects.'

(Ref 6) suggest the work the Division is doing may be in line with this thinking.

No one can predict the future but the Division is hopeful that it can build on its past successful IT initiatives and continue to provide its ITT students with the confidence and knowledge to be able to use and appreciate the educational potential that IT has to offer their subject discipline.

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WHO'S TEACHING OUR TEACHERS? TRANSFORMING EDUCATION THROUGH TECHNOLOGY IN TEACHER EDUCATION

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ABSTRACT

For the past few years, millions of dollars have been poured into technology in the public schools—monies used for hardware, software and staff development. Yet little has changed in the typical classroom. Delivery of instruction continues to be teacher dominated. Teachers tend to teach as they have been taught, and unless the cycle is broken, will continue to do so. In this paper, the authors examine the causes of the cycle—barriers to the appropriate integration of technology into teacher education programs; what can be done to break the cycle—retraining of teacher educators; and what must be done if the cycle is to be broken anytime soon.

INTRODUCTION

"The more things change, the more they remain the same."—Alphonse Karr

In the last twenty years, educators have learned a great deal about the science of teaching. We know more about how people perceive, retain, and utilize information and ideas. We know about cognitive styles, individual teaching styles, hemispheres of the brain, exceptionalities, diagnosis and remediation.

We know about technology, too. We know about the rapid evolution of circuits and chips into tools for information retrieval and processing. We know about the advantages of the effective utilization of technology in instruction, and we know what makes for effective utilization. It seems incredible, then, that the school classroom looks and functions much as it did twenty years ago—teacher dominated, self-contained, textbook-based, large-group oriented, supplemented with worksheets, bulletin boards, and an occasional audiovisual "aid."

Two reasons for this seems likely, and those reasons are inter-related. First, our teacher education classrooms look and function much as they did twenty years ago—teacher dominated, self-contained, textbook-based, large-group oriented, and supplemented with handouts and occasional audiovisual "aids." Second, while we know *about* technology, few of us have integrated it into our own teaching and learning. We might teach *about* it, but do we teach *with* it? Do we effectively model its use? And do we as teacher educators know *how* to plan for, utilize, and benefit from the technologies of instruction?

Let us assume for a moment that new teachers have been adequately prepared to utilize technology as a teaching/learning tool in their teacher education programs. The new teacher upon entering the real world of education will find little access to technology, and less opportunity to observe its effective utilization. The majority of teachers have not received training and are not providing models for the new teacher or for their students, some of whom will become teachers and teacher educators.

And the cycle goes on. What will it take to break the cycle and move instruction into the age of technology? Can it happen in teacher education, and what would it take to bring that about?

BARRIERS TO TECHNOLOGY IN TEACHER EDUCATION

Some of the barriers to effective integration of technology into existing teacher education programs are obvious, some are more subtle. Many of the barriers can be overcome easily while others will require far more than "an act of congress" to remove. Change is never easy and seldom comes without some cost, and that cost is not always measured in dollars and cents.

The college classroom. The typical college classroom is organized around the concept that a professor "professes" and students sit, listen to lectures, and take notes. Most college classrooms are not built to accommodate

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anything other than this traditional stand-up delivery of instruction. While many may be equipped with an overhead projector, the physical difficulty of providing adequate projection for films or filmstrips can be defeating, and the use of computers is relegated to a lab setting which is probably shared by tens of other classes.

College instructors seldom have ownership in a classroom. While this may at first seem similar to many secondary schools where teachers may move to different classrooms during the day, it is considerably more of a problem in universities. In a secondary school it is likely that the classroom will be "owned" by a course or a department if not by a teacher, and the environment can be arranged around the content of history or English or mathematics.

However, at the university level in a single day and evening, a college classroom might have eight to ten different instructors perhaps with widely different subject areas and teaching styles. This gives the instructor little opportunity to control the physical learning environment—to arrange furniture, lighting, the decor and technology to meet his/her instructional needs. Little of the class, its content, or of the instructor is left when the period of instruction is over. And security generally demands that expensive equipment be returned immediately to a centralized location.

Student expectations and preparation. Students come to college with expectations of what the classroom will be like. They expect to sit in large groups, listen, take notes, write papers, and take tests. Anything else is considered busy-work.

While there are some simple things teacher educators can do to begin to integrate technology into the curriculum such as requiring students to use application programs as tools for their own work, teacher educators do not want to teach the basics of such programs. Instructors may want students to use media in their presentations and in their research, but do not feel it is their responsibility to teach them how. While many students will come to teacher education programs with basic skills, many will not. Furthermore, it is not the responsibility of the content teacher to use class time to teach basic technological skills, and there are few places to refer them for assistance.

Time. Time is a generally a problem in teacher education. Demands on undergraduate programs to increase subject area content in courses outside the college of education have left less time for the foundations of instruction. Adding technology to the curriculum extends the number of courses required and/or requires that something else be eliminated or given less emphasis, and is compounded by the commitment to teach *about* technology and to teach *with* technology.

Time is also a factor in in the effective utilization of technology—time for learning about technology, time for finding resources, time for preview, time for planning, time for producing or adapting materials.

Resources. In order to integrate technology into the curriculum and to provide students opportunities to utilize technology for learning and for teaching, a great number of resources are needed. Adequate instructional materials to complement course content must be located or produced, cataloged, stored and easily retrieved; this requires time, money, and adequately trained support personnel. Sufficient equipment must be ordered, installed and maintained. Although it would be impossible to replicate in colleges of education the resources available in many public schools—however inadequate they may be—students must have a chance to examine and utilize media and materials at every grade level and in every subject area for K-12 education.

Organization of materials and equipment. Colleges of education are generally not organized around technology. Faculty frequently are unaware of what is available to them even when materials are centrally ordered and processed. Current procedures in many institutions provide for Professor Jones to order materials for his classes and to keep them in his office, even though Professor Smith in the next office may find the material to be exactly she needs. Few universities provide consulting services for their faculty in the selection and utilization of technology.

Training. Teacher educators generally have taught for at least several years and have taken time to complete advanced degrees and write dissertations before they being their college teaching career. Consequently, there may be a tremendous gap in what they were taught (if at all) about the use of technology in the classroom and what is currently available. Most of today's teacher educators may have had a course in "utilization of audio-visual materials," using equipment would be obsolete today. And, unless trained in business or mathematics, few would have had any experience with mainframe computers let alone the powerful personal computers currently in use. Little training is available for teacher educators. Faculty development programs are still scarce. Conferences in subject area fields provide little training on new technologies in instruction beyond demonstrations of equipment and materials.

Most teacher educators are as uncomfortable with technology as are their students—perhaps more so. They have had little training in and little access to technology. They do not know about review sources. They have few experiences in successful utilization of technology in their own public school teaching, and they have fewer models for using technology in their college classrooms. Those faculty members who do use technology tend to be self-taught. Few are aware of the body of knowledge related to instructional systems technology.

And in teacher education, as in every other segment of the population, there are those faculty members who are terrified of technology. It seems likely that no amount of force or training is going to get them to use it. Others simply are not interested or regard technology—particularly computers—as a passing fad.

Incentives. There are very few incentives for increasing the use of technology in teaching or to improve teaching at all for that matter. Currently universities provide incentives in terms of released time, raises, and promotions based upon the faculty's' research and publication efforts, not for the time and energy used to improve their instruction.

WHAT CAN BE DONE?

Awareness. We need to raise the level of awareness of teacher educators—awareness to technology, awareness to the changing nature of the world of information, awareness to the way technology can indeed be utilized to make their lives easier, awareness to their role in transforming education through technology. A faculty development program which treats technology as a priority would have a great impact.

Centralization. Policies need to be implemented to establish centralized acquisition and storage of materials. Professional staff must be hired to organize materials and to consult with faculty, assisting them with selection and integration.

Provide models and training for faculty. Faculty need the opportunity to visit college classrooms in their own or other institutions where technology is effectively utilized and to attend workshops to learn how to integrate technology into their instructional repertoire. Such activities should be a part of the continuing professional development expected of university faculty. While not all faculty will want training, opportunities and support should be provided for those who do.

Provide incentives. Universities exist to educate students. Therefore, the number one priority of any instructor at the university level should be the delivery of excellent instruction for their students. In order to deliver excellent instruction, faculty needs adequate planning time to organize and structure learning experiences. Collaboration with other faculty who have complementary expertise can enhance the design of instructional programs as well as foster writing and research opportunities. Teaching schedules must be established to make this collaboration feasible. It is less likely to occur when faculty must find time to work together than when planning time is provided.

Faculty need to be encouraged to experiment and try new ideas and technologies in their instruction without the fear of evaluations by students and supervisors which may effect their tenure, promotion and pay raises. Efforts put into improved instruction, curriculum and course design, and collaborative efforts should result in the same recognition as scholarly activities. Good teaching should not be incidental. It should be expected and rewarded.

Design dedicated classrooms. Principles of learning tell us there is a direct relationship between the physical environment and success in learning. With proper scheduling and cooperative planning, some classrooms could be designed to support specific courses or fields of study. Faculty using those classrooms could determine how to best organize the room and provide a stimulating environment for learning and teaching. Once designated, these classrooms must be adequately equipped and modified to accommodate existing and emerging technologies.

Professional Support Personnel. Colleges of education need to employ competent professionals with technical and interpersonal skills to consult with faculty and assist them in locating and developing technologies for instruction. These professionals in turn need staff and graduate assistants to support this service. In addition, the professional staff can assist in developing relationships with business, industry and community members.

Business and Industry Cooperation. Given the fiscal restraints under which most colleges and universities function, constant upgrading to state-of-the-art equipment is nearly impossible. Yet if we want students to select and utilize the best and most appropriate technology for their instruction, we must provide as wide a variety of experiences with a broad spectrum of current resources. If not, they may find their choices limited to those they have experienced. Students who have successful experiences in learning with technology will be more likely to use technology in their own instruction.

In order to have access to recent developments, it is imperative that universities develop cooperative agreements with business and industries that are designing and utilizing these technologies. Such cooperative agreements can only benefit both parties. College of education faculty have expertise in design , delivery and evaluation of instruction and can assist industry in their research and development efforts. Industry can showcase their products and equipment.

Take advantage of resident expertise. Faculty colloquia should be established to allow professors to share their expertise and experiences. While few faculty have been formally trained in the technologies of instruction, some have extensive training in instructional systems and design. Again, collaboration should be encouraged and alternative staffing patterns should be explored. Such collaboration may lead to new areas of research and provide insight into the uses of technology in different content areas and for students with varying skills, abilities and interests.

Implement curricula changes. Once teacher educators become more sophisticated in their uses of technology, it is imperative that the curriculum be restructured to integrate technology into all aspects of the program. Faculty who teach the more theoretical courses would model the use of technology in instruction. Faculty who teach general methods courses would not only demonstrate but provide opportunities for students to design, adapt and utilize materials. Special methods courses would give students an opportunity to broaden and apply their skills to their own subject areas. And student teaching experiences would take place in classrooms and schools where technology is utilized and resource-based education is the norm. Faculty expectations of students' utilization and production of technology would increase and the college would support students technological skills with facilities, materials, equipment and consultation services.

WHAT MUST BE DONE?

The breaking of the "non-technological instruction" which dominates education rests entirely in the retraining of teacher educators. Teacher educators must

- realize the value of technology in instruction;
- learn how to use technology effectively;
- have the support and resources to retrain and to redesign their curricula;
- be adequately regarded and recognized for their efforts to improve instruction;
- learn how to cooperatively function in a competitive environment and to share levels of expertise;
- envision life beyond the traditional classroom and access resources wherever available;
- be committed to the improvement of instruction and cognizant of the significant role technology plays in shaping the future of education.

It must be noted that the key to success in implementing changes that would result in the integration of technology into the teacher educational curriculum is the commitment and support of the administrative personnel at various levels within the college/university organizational structure to the importance of technology in the teaching/learning experience, without which all would be for naught.

KNOWLEDGE-BASED LEARNING ADVISORS

F N Arshad*

ABSTRACT

A design methodology for a computer based Advisor is presented which is capable of providing students with study advice. Advice in this context consists of choosing study goals for the learner and suggesting methods of achieving these goals. Information of the conceptual relationships in the domain, and the user model is employed for tailoring the advice to particular requirements of the student.

INTRODUCTION

In recent years tertiary level education has seen an unprecedented increase in the range of teaching/learning resources available to students. As well as traditional materials, students also have a choice of using computer-aided instructional modules. In addition to the differences between these two types of resources, there is a great amount of diversity of style within the materials, and they are rarely well co-ordinated in the overall curriculum (Hartley and Tait, 1986). This can cause problems for the student.

Tertiary education invariably expects the student to shoulder much of the burden of decision-making during learning. As well as having to decide what topic to study, the student also has to decide how to study it and which learning materials to use. Although it is commendable that students take such responsibilities, they may not always be clear about their knowledge requirements or their lack of understanding, and may not employ effective learning styles or study skills.

Such problems can be alleviated through a supportive learning environment able to provide study advice. Such support may take the form of a computer-based Advisor.

THE NEED FOR COMPUTER-BASED ADVICE

The provision of such advice must be guided by several types of information. The nature of the course (or subject matter) which the student is to learn is clearly important, as is the availability of different types of teaching/learning resources. Because this material is directed at learners, it is necessary to have data about students, their background knowledge, and their preferred style and method of learning. Other constraints (e.g. time and confidence variables) which have a bearing on the learning should also be taken into account.

The need for advice was shown in early computer-based learner control systems; the developers of TICCIT (Alderman 1978, Merrill 1980) made some attempts at providing such advice based on performance data, but they did little more than provide a series of mastery hurdles. Lately though there has been a shift of interest towards expert systems capable of giving study advice (Golombic et al 1986, Frank et al 1988). Other notable work

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which has influenced the current research has been the work of Lesgold (1988) on a theory of curriculum, and work on course planning (e.g. Peachy and McCalla 1986).

LOLA (Leeds On-Line Advisor)

LOLA, although given a generic formulation, has been designed to support the learning of Applied Statistics at undergraduate level. The design principles outlined below were informed by studies of experienced teachers who were asked to organise course information into networks and give study advice appropriate for various types of students. Study advice in this context comprises a plan of action for students giving sequences of goal topics (from a possible network of topics). Teaching materials are then identified for a student to learn the topics in a manner consistent with his/her style of learning. Hence, student variables are used both to tailor the plan of study and implement it through the selection of specific teaching/learning materials. For this decision-making LOLA uses three types of information, outlined below.

DOMAIN REPRESENTATION

Subject matter is represented as networks consisting of nodes and labelled arcs. The nodes denote topics which can be learnt, whilst the labelled arcs denote relationships or links which exist between them. The topic network distinguishes between three types of nodes. Root nodes represent most general topics in the network. They only have arcs entering it. Organising nodes represent the next level of generality, these nodes have arcs entering and leaving them. Finally, the least general set of nodes, called the Leaf nodes are located at the bottom of the network; these only have exit arcs.

Each node representing a topic contains several types of information e.g. topic node label, a description (conceptual knowledge), summary of techniques e.g. mathematical calculations associated with the concept (procedural knowledge) and knowledge for applying the concept procedures in context (operational knowledge). Note that many topics do not contain all three types of knowledge.

Several classes of labelled directional arcs representing relationships between topics were identified from the experiments and these have been included in the domain representation. A distinction is made between arcs showing (related) topic nodes which are pre-requisites (contains, applies-to) and those which show relations between the root-organising nodes (part-of, types-of and specialisation). The distinction allows the topic lattice to be represented as an inter-connected set of AND/OR trees. The utilisation of such links in decision-making will be illustrated later.

ASSOCIATED TEACHING MATERIALS

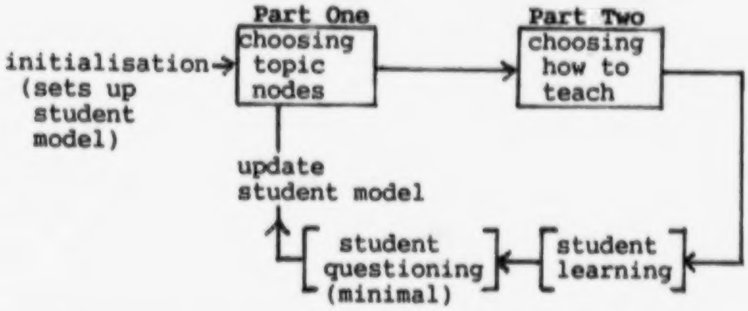
This module consists of a representation of the available materials which can be used by the student to learn the information in the domain. Several types can be used to learn a topic but only some of the functional styles of the materials (which govern the type of learning interactions) may be appropriate for a student. Expository learning of concepts can be promoted through textual materials (extracts from books with illustrations) but it could also be delivered as Test-teach pre-stored computer-based modules. Alternatively illustrations could be given in directed or exploratory forms through a Stat-lab (e.g. MINITAB). Other materials varying in their support levels and styles could also be used. The actual choice between these materials will depend on study goals, the students knowledge of that topic and other variables identified in the student model.

STUDENT MODEL

This model consists of two types of knowledge about a student. A 'student profile' comprises his/her (mathematics) background knowledge, time for study, and preferred style of learning. The last include directed/ investigatory methods, and also make a distinction, following Pask (1976), between Serialist and Holist learners. Serialist learners prefer to learn in a focused step-by-step method with access to few topics at a time, whereas the Holist prefers access to several topics, permitting a range of contrasts to be made. Direct questioning with the student results in this profile being constructed.

The second component, the 'student image' represents the learner's understanding of the subject matter. This is shown as a subset (or overlay) of the domain with knowledge in this subset marked as known, partly-known or unknown. This data is obtained from performance with on-line task materials, or through an on-line test of the topic. These measures will be used by the Advisor in its planning decisions and also in the selection of types of materials for learning.

ADVICE-GIVING IN LOLA



Advice-giving is considered a two stage process. On the first interaction with the Advisor, the student model is initialised. The first part of the decision-making machinery to be put in motion involves choosing appropriate topic nodes to form a study sequence for the learner: the second part involves choosing how to teach the topics (i.e. how the learning goals are to be achieved). Each set of topics to be learnt represents a relatively short period of work, the number of nodes varying according to the domain and the student model. After the teaching materials have been selected under the topic goals, control passes to the student who should follow the study plan. On subsequent interactions the system attempts to identify the success or failure of the plan and these results are then used to update the student model and initiate the process of finding a new or reused study sequence.

ADVISORY RULES

Having decided on the domain of interest (identified by the root node and those linked to it) the Advisor constructs a study sequence from these topic nodes. Rules allow searches to be made following the selection of different approaches e.g. top-down analysis or bottom-up synthesis, and depth-first specialisation or breadth-first differentiation. These determine whether the study scheme follows node strands or focused/unfocused sub-trees. The resulting types of candidate plans (which employ the different organising methods) will suit different students depending on their learning style (serialist/holist), and on their background knowledge. Within the chosen type of plan other controlling rules use arc-knowledge of pre-requisites (e.g. 'a' contains 'b') to determine sequence, and the AND/OR junctions (i.e. part-of, type-of) arcs to set sub goal conditions. Knowledge strength measures are used to follow either 'strong' or 'weak' routes, whilst knowledge type rules are used to organise goal development (e.g. conceptual/procedural knowledge is a requirement for operational knowledge).

The second set of advisory rules embody educational policies which represent teaching actions judged appropriate for each of the topic nodes. Educational policies enable the system to control different types of interaction with the student, e.g. introduce new concept information, consolidate with procedural knowledge, repair misconceptions, or summarise and extend learning to other unknown inter-linked topics.

To summarise, the Advisor considers the study scheme for a topic domain before deciding on a next-node sequence, and utilises arc information when determining the organisation and sequencing of study nodes. Once the nodes and educational policies are decided, then selections can be made from the database of materials and presented to the student.

CONCLUSION

The functionality of the Advisor is twofold. First a suitable route is planned through a defined curriculum and this route (and its study content) is responsive to the immediate needs of the student. Second, the system provides a design methodology for tutors, enabling them to construct a topic domain to allow the advisory software to be used with their own students. In this respect the design is potentially domain independent.

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Acknowledgement I wish to thank the ESRC for funding this project and J R Hartley for his supervision. Thanks are also due to K Tait and G Kelleher for many helpful discussions, and to D Hobbs for his implementation effort.

COMMONSENSE REASONING IN MATHEMATICAL PROBLEM SOLVING

Y B Reddy*

ABSTRACT

For the past two decades expert systems were designed to solve problems in mathematics, physics, etc. (ref 5). While simplifying algebraic expressions systems fail to proceed further whenever the simplified version is not better than the existing one (generally related to number of binary operators and terms). In such situations the human tendency is to reason to proceed further or stop the further simplification or try for alternative solutions with the existing constraints. An attempt is made to provide the commonsense reasoning whenever such situation arises.

INTRODUCTION

Most of the times, while trying to solve a problem, it is desirable to suspend the present status of the problem when the results are not satisfactory, and generate the reasons to reason about the problem. The reasoning helps to lead to a new problem with satisfactory solution, or possible alternative methods from previous time intervals, or noted failures. The process of suspending the problem, reasoning about the problem and using the results to control the subsequent problem is called reflection (ref 1,2,3,4). Generally, the reflection principle is the relation between theory and metatheory.

The motivation for studying the reflection methodology is the assumption that it is easier and common in the problem solving methods with the useful results. Many times it is quite possible that we may end up with better solution or with no solution. But human tendency is to solve any given problem with the previous experience, i.e. by using known and solved examples and comparing the results at different stages, or reason for satisfaction. For any mismatch or unsatisfactory solution at any stage of progress to solution, suspend the problem, save the present status and solve the problem by (a) looking back or (b) proceed further. By looking back means, backtrack to previous steps and use the alternative methods which are known with previous experience. By proceeding further with subsequent calculations (eventhough the results at present stage are not satisfactory) there will be a possibility of ending with a better solution. This procedure, most of the times, leads to a new satisfactory solution.

In the present paper, the simplification of an algebraic expression with appropriate constraints is discussed. Each stage of the simplification is listed. The truth or falsity of each stage is deduced by the basic inferential system created. The logical possibility is determined by using the model logic Z (ref 1). The learning process is observed through backtracking.

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THE MODEL LOGIC Z

The purpose of the present paper is to use the model logic Z while simplifying an expression. The object logic will always be in capital letters as in Brown (ref 1) and parenthesis are used whenever necessary. Concepts of set theory and LISP (ref 4) are used whenever necessary. Most of the symbols are used for convenience. The symbols AND, OR, NOT, IFF, EX, etc., are defined as in Brown, but the new logical symbols introduced at present are explained. It is important to note that the set of logical symbols, the set of variables, the contingent verb symbols, and necessary verb symbols are all pairwise disjoint sets. The set of sentences of Z are the smallest set which includes variables, constants, mathematical functions, relational symbols and is closed in normal way of forming new sentences.

The static belief theory consists of all axioms of model logic Z. For example:
(BEL A P K1) = df (ENTAIL (BEL A K1) P)
means that the state of A's belief at situation K1 holds P. Similarly,
(BEL (SUB G E) E1 K1) = df (ENTAIL ((BEL G E) K1) E1)
means substitution of condition G in the expression E holds the expression E1 at situation K1. Therefore (IF (LT(SAT E1 G K1)) E1) means that E1 is possible only if E1 is satisfied with substitution G at situation K1. So it is allowed for further simplification.

Since there is a close relationship between action model and belief theory, it is always better to present the action model before we start the problem. The model is useful for the reflection reasoning (ref 1,2,3) and syntactic manipulation. The action model AM is defined as a five tuple as explained below:
AM = (K, ACT, DO, R, G)
where

K	is a set of propositions or situations including the initial situation.
ACT	set of actions which are finite. It is also known that for every action there must be a pre-action followed by result.
DO	the function followed by a action frame law.
R	is set of restrictions or constraints.
G	is the set of substitutions or conditions to simplify the expression.

Using the model the logical possibilities are explained and the multiple solution possibility is not discussed.

THE PROBLEM

The database considered consists of the basic set of facts and rules which includes model logic Z axioms which are called static axioms. The dynamic rules are created, used and recreated. The mathematical expression (E) in the present case is KN + LM with the facts of variables and operators together with the rules of forming the arithmetic expressions. Since E is the base expression of the database and E1, E2, ...be the first, second,.. simplified versions of E. Let G1, G2 be the constraints for simplification. The axiom (ENTAIL E E1 G1) means E causes E1 with the help of G1.

Let us define (LT (IF (SUB E G1) E1)) as it is true that substitution of G1 in E simplifies the expression to E1. There are cases where E1 is not acceptable by the system and the system stops to do further simplification. The basic law of action states that the simplified version will be accepted or rejected depending upon the logical equality of different frames which are pre-specified for reflection.

The function (DO ACTION E) applies the action (ACTION) to the situation E which provides the succeeding situation. The succeeding situation contains results of the action, the restrictions which are true in E are true in succeeding new situation. The generators be E and G, where E is the expression and G is the substitution function. Consider the following substitutions:

```
  (STORE F1 E)       =  df  (ALL E(IF (LT E) (LT F1)))
  (SUB E G)          =  df  (ALL G(IF (LT E) (LT (E G)))
  GENERATORS         =  df  (S   SUB)
  (RESTRICTIONS E)  =  df  (OR (ELE E GENERATORS) (ELE (NOT E) GENERATORS))
```

where SUB is used for substitution and S is used for satisfaction of result. The expression and the constraints to simplify the expression are explained in Appendix 1. Also, Table 1 explains the derivation

$$E \overset{a1}{\Longrightarrow} E1 \overset{a2}{\Longrightarrow} E2 \Longrightarrow E3$$

where E1 derives (==>) after substitution for a1 and E2 after substitution of a2 and E3 for further simplification. From Table 1 it is clear that system fails to continue from E1 to E2, so the logical explanation is necessary to continue. The need of model logic arises for appropriate decision to proceed further. It is also observed that each situation of E is a frame, and comparison is only the frames generated at different situations.

The basic frame derived for the present problem is similar to Brown. The variable S provides the satisfaction of derived expression at a given situation K1, compared to pre-expression. The basic frame of substitution, with facts stored in resulting situation is:

```
(SYN (DO ACTION K)
   (AND (IF ENTAIL K(PRE ACTION)) (RES ACTION))
   (IF (AND (ENTAIL KO S) (POS (AND (DO ACTION K)S)))S)
   (IF (AND (ENTAIL KO B) (POS (AND (DO ACTION K)S)))B)
   (IF (AND (ENTAIL KO (NOT S)) (POS (AND (DO ACTION K) (NOT S)))) (NOT S))
   (IF (AND (ENTAIL KO (NOT B)) (POS (AND (DO ACTION K) (NOT B)))) (NOT B))
```

Starting from situation K0 where the initial expression is provided and continuously apply the substitution to simplify the expression. The situation K1 is derived as follows.

```
(SYN K1 (DO LOAD KO))
(SYN K1 (AND (IF (ENTAIL KO(PRE SUB)) (RES SUB))
             (IF (AND (ENTAIL KO S) (POS (AND K1 S)))S)
             (IF (AND (ENTAIL KO B) (POS (AND K1 S)))B)
             (IF (AND (ENTAIL KO (NOT S)) (POS (AND K1 (NOT S)))) (NOT S))
             (IF (AND (ENTAIL KO (NOT B)) (POS (AND K1 (NOT B)))) (NOT B))
```

Similarly the situation K2 will be derived. The satisfaction of derived expression means that the system allows further simplification. But for any negative results system should reason depending upon the situation. So the definition of reflection applies. For example in:

```
   (SYN K1(AND B S))
   (IF (AND B (NOT S)) (DO ACTION Er))
```

the action function Er will be executed whenever the results are not satisfied and system fails to continue in normal conditions. In such cases the reflection principle has two states. First, it stores the present status and proceeds further, and in second it backtrack to alternate situations. The reflection state with F1, F2 as comparison frame is given by:

```
(SYN K (DO ACTION E)
       (OR (IF (AND (STORE F1 E) (POS (ENTAIL B E1) E1) (STORE F2 E1))
                                          (DO ACTION E1))
           (ALL F1 F2 (IF (POS (S F2 F1)F2) (DO ACTION E1) (RES E2))
           (AND (ALT B) (DO ACTION E) (RES E))))
```

where ALT B assumes the substitution from the beginning with the alternative method. This type of restart may help for possible results.

CONCLUSION

The simplification of the algebraic expression in the system MACSYMA, is done by SCSIMP (ref 6). Since the failures occur whenever the simplified version is larger than the pre-simplified one, an alternative solution is required. The alternative solution is only the commonsense reasoning whenever such situation arises. The present proposal is one of the solution to such problems. Since the commonsense reasoning and reflection move parallel the model logic Z is chosen for best possible solution. Multiple solutions and selection of best solution is not discussed in the present case.

Table 1: Explanation table for simplification of expression e.

	E	E1	E2	E3
no. of variables	4	3	2	2
sum of the exponents	4	5	2	2
no. of binary operators	1	2	2	1
no. of terms	2	3	3	2

note: unary operator is not accounted.

APPENDIX 1

Assume the given expression (E) is KN +LM and the constraints G1 and G2 are K + L = 1 AND N − M = 1 . The expression can be simplified by eliminating K,N or K,M or L,N or L,M ; where the four variable expression can be converted to two variables. The search-oriented simplifier (SCSIMP) in MACSYMA, which follows a set of rules in simplifying the expression and continues the process as long as the new result is smaller than the previous one. The process will be as follows.

$$KN + LM \qquad (1)$$

solve for L and substitute in (1)

$$KN - KM + M \qquad (2)$$

solve for N and substitute in (2)

$$K + M \qquad (3)$$

(3) is obviously the right answer, SCSIMP would fail to find its search since the intermediate state (2) is larger than the initial state (ref 6).

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Title: Learning from Hypermedia: the development of an integrated environment for authoring and learning on the Macintosh

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Abstract:

In this paper we describe a novel hypertext system for exploratory learning and report on two distinct methods for its evaluation. The system centres around a new approach to the problem of linking frames in large-scale hypermedia systems. As a result, we claim to have designed and implemented a system with some measurable advantages over more conventional approaches to Intelligent Computer Assisted Instruction (ICAI) and to hypermedia systems in general.

In its most recent implementation, in HyperCard, the system we have named *StrathTutor* integrates the authoring and learning environments into a single coherent interface. As Brown (1) has pointed out with respect to *Guide* this integration of the author and user viewpoints is one of the keys to success of hypertext systems. In its general form *StrathTutor* provides the learner with a Macintosh interface through which the hypermedia may be browsed, searched for novel concepts or used as a guide for 'touring'(2). Thus *StrathTutor* provides the kind of learning support tools called for in Hammond & Allinson's (3) critique of learning from hypertext. Its main feature, however, is its separation of the underlying knowledge representation from the instructional material itself. The 'author' of a tutorial creates frames, each frame being one or more screens of text and graphics produced using standard Macintosh utilities. Each frame is assigned an attribute coding from a set of attributes previously designated to represent the overall conceptual content of the tutorial. From this attribute coding, algorithms compute across the entire unseen frame-base to identify the best 'next' frame (4). Thus all links are computed at run-time and the author of the tutorial has no concern with the linking of frames, nor any higher-order organisation over and above the separate representation of each frame's attributes.

From the learner's viewpoint *StrathTutor* offers a variety of tools for exploration of the instructional material. Interaction proceeds entirely through direct manipulation and pull-down menus. This makes the system usable by a wide range of potential learners, some of whom we have been observing in action with the system. Our evaluation has involved two rather different methodologies. In conventional pre- and post-test experiments we have studied groups of students learning either with *StrathTutor* or with the same material delivered in expository form by an instructor. Latterly we have employed a method called 'constructive interaction' to generate dialogues from pairs of learners proceeding jointly to explore the knowledge. This turns out to reveal many qualitative aspects about learning from this system that may be applicable to learning from hypermedia systems in general.

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LOGIC ACROSS THE CURRICULUM

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ABSTRACT

Every human discipline claims some affect on the critical thinking and problem solving skills of its students; furthermore, every human discipline uses some form of logic in its pursuits. Are these obvious facts being ignored in the education of junior high school students? LOGO, an artificial intelligence programming language, has found success in the elementary school curriculum of the United States. Yet in junior high school, the tendency is to abandon the microworlds of learning and to teach the programming language of BASIC. It is the thesis of this presentation that PROLOG (PROgramming LOGic), another artificial intelligence programming language, is a vehicle for integrating logic across the curriculum. PROLOG continues and expands the logical thinking skills and the microworld learning environments that have been established with LOGO.

INTRODUCTION

It has been ten years since Papert wrote his now famous book, Mindstorms (ref 1), and almost as long since LOGO, his artificial intelligence programming language, became available on the Apple II. A recent review of research literature from 1980 - 1987 (ref 2) touts the educational effectiveness of LOGO and suggests that future funding be directed to the use of LOGO applications to teach problem solving and increase creativity. As LOGO has grown in popularity in the elementary curriculum, BASIC has been relegated to the junior high curriculum (ref 3). This seems to have just happened without much thought being given as to why it should or should not be that way. Purchasing LOGO is an additional cost for elementary schools, yet it has become firmly implanted in the elementary curriculum. Why? Because LOGO meets a perceived need and it complements the existing curriculum across subject areas. Given that BASIC is usually the only high-level programming language available for no cost, its relegation to the junior high curriculum might seen an approprate balance in an administrative budget; furthermore, it is viewed as somewhat of a "more grown-up" programming language. With LOGO installed in the elementary school curriculum, is BASIC in the junior high school curriculum consistent with what students have learned using LOGO?

While much has been said and written in the United States (U.S) about LOGO, relatively little has been noted about another artificial intelligence programming language,

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PROLOG. PROLOG, an acronym for PROgramming LOGic, was brought forth from obscurity in 1981 when the Japanese ICOT Fifth Generation Computer Project selected it as their "language of choice." The PROLOG environment is based on logic, something that is neutral regarding subject content yet something that should be a unifying force across the curriculum and across life. In the "real world" today, PROLOG is being used to write such diverse software packages as relational database management systems, and expert systems. The subject content of these systems will be determined by their users -- sociologists, economists, lawyers, accountants, doctors, and others. PROLOG is also being used in application specific programs such as natural language interfaces. Yet little is known in the U.S. about the educational uses of this powerful tool. To put this into some prespective, over the last four years in the *Journal of Educational Computing Research*, for example, there have been 14 articles about LOGO and its use, and only one about PROLOG. The majority of educational information about PROLOG comes from the United Kingdom, and most of these journals are not available to the average U.S. educator. It is safe to say that PROLOG is virtually unknown by U.S. pre-college educators. It is the thrust of this article to heighten the awareness of U.S. pre-college educators that microworld learning developed in LOGO moves quite naturally into PROLOG microworld learning. In this light, PROLOG is probably more appropriate for junior high school students than BASIC.

WHY PROLOG?

PROLOG is a natural extension and expansion of what educators are teaching students using LOGO. In answering the question, "Why LOGO?" in 1982, Harvey (ref 4) presented a recursive LOGO solution to the Tower of Hanoi problem suggesting that BASIC could not be used this way. Below, side by side, are a LOGO program and a PROLOG program:

```
TO HANOI :N :FROM :TO :OTHER        hanoi(0,From,To,Other):-!.
IF N = 0 [STOP]                     hanoi(N,From,To,Other):-
HANOI :N - 1 :FROM :OTHER :TO         D is N - 1,
PRINT (SENTENCE [MOVE DISK] :N        hanoi(D,From,Other,To),
 [FROM PEG] :FROM [TO PEG] :TO)       printr('MOVE DISK ',N,
HANOI :N - 1 :OTHER :TO :FROM           ' FROM PEG ', From,
END                                     ' TO PEG ', To),
                                      hanoi(D,Other,To,From).
```

The LOGO program would be invoked by HANOI 3 "A "B "C while the PROLOG program would be invoked by ?-hanoi(3,a,b,c). Harvey went on to say that the benefits of LOGO are that it is interactive, recursive, not a typed language, extensible, and a learning language. All of this can also be said for PROLOG.

Unlike LOGO and BASIC which are procedural languages. PROLOG is a declarative language which introduces logic programming. Logic programming opens PROLOG's use in a great variety of subjects because it combines "the benefits of both the logical form of description for the user, and the power of the computer which takes such descriptions as programs for solving problems." (ref 5)

As with LOGO, distinction between the PROLOG language and any particular implementation of PROLOG should be noted. For example, Turbo PROLOG is a compiler implementation which requires typing of variables and supports graphics, while Chalcedony PROLOG is interpretive with no typing of variables and does not support graphics. Micro-PROLOG supports turtle geometry and this provides an even smoother transition between LOGO and PROLOG (ref 6).

MICROWORLDS

One of the greatest gifts that LOGO has given children has been discovery learning in very real microworlds constructed about powerful ideas. Collis (ref 7) presents some powerful ideas which can be used to demonstrate how to apply logic across the curriculum. Three PROLOG microworlds can be developed based upon lessons found in social studies, language arts, and science. "A well-designed microworld embodies the simplest model that an expert can imagine as an acceptable entry point to richer knowledge." (ref 8) It must also have a "neat" phenomena; that is, it is interesting to observe but more fun when interaction is allowed. Because of the quick phase development prototyping capabilities of PROLOG, all three of these microworlds have the neat phenomena feature.

Development of a database in PROLOG is quite natural and most likely the first venture a student would take into the language. The ME microworld is a social studies lesson that can involve a student in human systems with patterns and processes. Using appropriately named predicates, a students can describe a very personal microworld of facts:

```
person(tammy).  female(tammy).  born(january,30,1975).
animal(princess).  dog(princess).  owns(tammy,princess).
```

This factual database can grow very quickly as other people and pets in the student's life are added. A more complex relational database can be established when the student constructs rules relating current facts:

```
loves(Person,dogs) :-
  person(Person),owns(Person,Something),dog(Something).
```

It is a significant educational experience to have students discover the "rules" for being an uncle, a grandparent, or a sibling. With this ME microworld, the student can also develop basic skills in constructing queries.

Language arts can be a very fertile area for the application of PROLOG. Students enjoy playing with words and sentences. Language generators are easy and quick to develop. The ADD-LIB microworld can cause a good many laughs but more importantly students can discover the difference between syntax and semantics. The heart of the ADD-LIB microworld is the logic involved in generation:

```
generate(Type,Result) :-
  phrase(Type,Components),makeup(Components,Result).
generate(Type,[Type]) :- word(Type).
```

The makeup predicate would recursively append words from the Components list into the Result list. The task of getting a computer to reproduce meaningful human language is truly an adult problem on which some students will enjoy working.

The BEE microworld is a science lesson which would allow a student to simulate how a bee would search for nectar while avoiding spider-webs and birds. Basically, this involves the construction of a maze which the bee must traverse, find the nectar, avoid predators, and return to the hive. This microworld can grow as the student broadens the bee's horizons, creates rules as to where nectar can be found, and increases the dangers to be avoided.

CONCLUSIONS

Logic is a medium in which many different subjects can be described. PROLOG is an implementation of logic programming which continues to offer the same discovery learning environment enabled by LOGO. PROLOG should be considered for use across the curriculum but very specfically in the junior high school curriculum. If nothing else, these students will have at least become familiar with a fifth generation programming language.

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USING AN EXPERT SYSTEM SHELL TO CREATE A COMPUTER AIDED INSTRUCTION SYSTEM

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ABSTRACT

This paper examines some of the problems in using an expert system shell to develop CAI material. The 'British Highway Code Tutor' has been created to teach the British Highway Code, using the expert-system development tool 'Personal Consultant Plus'. The subject matter is divided into several lessons, and is presented to the student in the form of text and pictures. TRUE/FALSE and MULTIPLE-CHOICE questions are used to gauge the knowledge that a student has gained in a session with the tutor. Pictures have been incorporated into the system via PC-Paint because of the essentially visual nature of the subject matter. Among the issues discussed is the role in the construction of CAI systems of the Review? (What?), How? and Why? explanation facilities provided by an expert system shell such as Personal Consultant Plus.

SYSTEM DESIGN AND IMPLEMENTATION

Personal Consultant Plus is an expert system shell which:

1. provides antecedent and consequent rule forms;
2. provides a frame based representation to partition the knowledge, thus allowing subdivision of the subject matter of CAI systems into several lessons, each of which can be developed independently;
3. provides facilities to incorporate graphics in knowledge bases;
4. allows incorporation of user defined functions coded in TI Scheme LISP in knowledge bases;
5. provides meta-level rules for the developer of CAI systems to control the way PC Plus fires rules according to need;
6. provides facilities to design and incorporate YES/NO, MULTIPLE-CHOICE and SHORT answer questions expecting single or multi line text replies. It also allows the inclusion of graphics in the prompt for a question; and
7. provides built in predicates to allow the developer to perform simple arithmetic in the knowledge base.

The subject matter of the 'British Highway Code' tutor has been divided into seven lessons. Each lesson gives instructions about a particular area of the Code. Moreover, every lesson has been subdivided into several sublessons so that the student should not get bored due to the length of the lesson. The tutor has been designed to provide two types of tutoring schemes namely 'TEACH-AND-TEST' and 'TEST'. The student can select one of the two tutoring schemes at the beginning of the session. In the former case, the tutor first teaches the student by presenting texts and pictures. At the end of each sublesson there is an interactive review. With the TEST option, the tutor simply quizzes the student.

The knowledge base of the tutor consists of 180 rules and 160 pictures. The total size of the tutor apart from the pictures is 200 KB and the pictures take about 900 KB.

PC Plus provides antecedent and consequent rules for knowledge representation. Antecedent rules are the forward chaining rules and the consequent rules are the backward chaining rules. In addition, PC Plus provides SELF REFERENCING rules i.e. rules which reference the same parameter(s) in IF as well as THEN clauses. A self referencing rule may be either antecedent or consequent.

An application that is being implemented using PC Plus can thus be designed in three ways:

1. Forward Chaining, using antecedent rules,
2. Backward chaining, using consequent rules, and
3. Mixed type, using both antecedent and consequent rules.

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In fact, self referencing consequent rules have been used to deliver the lessons of the tutor. For each lesson a dummy parameter DELIVER-?????-LESSON has been included into the goal list of the parent frame TUTOR as shown below:

```
Frame properties : TUTOR
TRANSLATION :: The British Highway Code tutor
INITIALDATA :: TUTORING-METHOD LESSON-TO-BE-DELIVERED
      GOALS :: DELIVER-FIRST-LESSON DELIVER-SECOND-LESSON ...
 IDENTIFIER :: "TUTOR-"
```

In order to query the student, the tutor can ask both YES/NO and MULTIPLE-CHOICE questions. Some of these questions also include graphics in their prompts. These questions can be implemented using forward chaining, backward chaining or both the forward and backward chaining rules.

In a forward chaining implementation, the questions are included in the goal list of the frame associated with a lesson or sublesson and the antecedent rules depending on the values of these questions are included into the rule group associated with the lesson or sublesson frame.

In a backward chaining implementation dummy parameters are included into the goal list and in the action part of the consequent rules.

The mixed implementation is essentially the same as with backward chaining except that some rules are antecedent and some are consequent.

The table shows the size of a lesson implemented in each of the three schemes. It is evident that the forward chaining approach is superior to the other two as far as space is concerned.

Implementation	Size of lesson 1 in bytes
Forward Chaining	16460
Backward Chaining	17746
Mixed	17348

AN EVALUATION OF PC PLUS FOR THE IMPLEMENTATION OF CAI MATERIAL

PC Plus, in general, provides good facilities to develop a CAI system like the 'British Highway Code' tutor, but there are problems which we discuss in the following sections.

TEXT AND GRAPHICS COMBINATION

If the organisation of a lesson is such that it displays one or more pictures first and text later, the behaviour of PC Plus is quite reasonable. After each picture has been displayed PC Plus prompts for <RETURN>, and when the last picture has been shown, it displays text and again prompts for <RETURN> after each full screen of text. However, when the organisation of a lesson requires text to be displayed first and picture(s) later, the behaviour of PC Plus is un-satisfactory. After displaying the last screen of text, it does not prompt for <RETURN>, but displays the first picture immediately. Due to this strange 'behaviour', it is not possible for a student to read the complete text of the last screen. One way to overcome this problem is to append a blank screen before the first picture!

SHORT QUESTIONS

PC Plus provides facilities to incorporate YES/NO, MULTIPLE-CHOICE and SHORT questions in the CAI systems. The reply to a SHORT question can be a number or text. There are some difficulties with the implementation of SHORT questions. If the student's response is assumed to have exactly one space between the words of the text, and he/she intentionally (or by mistake) types a response having one or more spaces in the text, then that reply will be considered wrong even though it was in fact correct. If this implementation was such that the spaces in the text were ignored or if a line of text was implemented as a list of words, and the two lists were compared, then the problem would be eliminated. Meanwhile another way of overcoming this problem would be for the developer to write a function in LISP that removes extra spaces between the words of text, thus leaving only one space in between each word before comparing the answer with the correct one.

THE 'REVIEW' COMMAND

The REVIEW command (some expert system shells call this the WHAT facility), in general, permits the expert system user to review his/her answers and possibly, make some corrections to parameter values. This command may give a CAI developer some problems if, for example, the CAI system is counting the number of correct and incorrect answers and the student now changes a wrong answer so that the count of correct answers should be increased. If the implementation is not capable of decreasing the count of wrong answers at the same time then the grading will be wrong.

This suggests that there should be a way to inform the CAI developer that the REVIEW command is in action. PC Plus does not provide such a facility directly but provides facilities at the meta-level to tackle the problems that may arise because of this command.

For example, in our tutor, the knowledge base contains at least two rules for each question, one taking care of a correct answer and the other of an incorrect answer as shown in Fig. 1. During the consultation, when the student replies to a question only one of the two rules shown in Fig. 1 will be fired. If the student's reply was incorrect, then rule RULE020 will be fired and rule RULE019 will be left unfired. Now, if at some later stage the student uses the REVIEW command and replies correctly then the meta rule

```
  IF :: IFFIRED PEDESTRIANS FREEVAR
THEN :: WSCORE = VALUE WSCORE - 1
```

will take care of the already fired rule concerning the incorrect answer and will decrease the count of incorrect answers. The rule concerning the correct answer which was not fired during the consultation will then be fired and thus will increase the count of incorrect answers.

Fig. 1 <u>Two rules from the knowledge base of tutor</u>

```
RULE019: [PEDESTRIANS/Antecedent]
         IF :: QUESTION1.2 = LEFT-SIDE
       THEN :: PRINT (TEXTNAME ANSWER-IS-RIGHT)
               AND SCORE = 1 + VALUE SCORE
RULE020: [PEDESTRIANS/Antecedent]
         IF :: QUESTION1.1 = RIGHT-SIDE
       THEN :: PRINT (TEXTNAME ANSWER-IS-WRONG)
               AND WSCORE = 1 + VALUE WSCORE
```

THE 'WHY' COMMAND

If the knowledge base of a CAI system has been developed by using antecedent rules and, during the consultation, PC PLUS is asked to trace the value of some parameter - QUESTION1.1, say - it prompts the user. If at this point the user selects the WHY option, PC PLUS's response is:

```
-Why:─────────────────────────────────────────────────
       Reply to the question:
       Which side of the road should pedestrians walk  if
       there is no footpath or pavement along the road?
       is needed to determine information about
       the rules for road users on foot.
** End - RETURN/ENTER to continue
──────────────────────────────────────────────────────
```

This response to the WHY question does not make any sense to the student, mostly because the phrase 'is needed to determine information about' is substituted into the reply by PC PLUS automatically. If such phrases could be custom built, then it could be replaced by 'is needed to asses your knowledge about', so that the response to the WHY question makes sense in context.

If a question is implemented with either backward chaining or in mixed form, PC Plus will display the rule(s) currently being processed as shown below:

```
-Why:─────────────────────────────────────────────────
       If  Reply to the question:
           Which side of the road should pedestrians walk if
           there is no footpath or pavement along the road?
           is RIGHT-SIDE,
        then  1) inform the user of this decision, and
              2) it is definite (100%) that score equals
                 [ 1 plus score ], and
              3) it is definite (100%) that ASKQ1.1.
      ** End - RETURN/ENTER to continue
```

The correct answer to the question is RIGHT-SIDE. It is evident from the above response that a cunning student may discover the right answer to the question in this implementation by asking the WHY question. On the other hand, a forward chaining implementation hides the rules, and hence the correct answers, from the student.

THE 'HOW' COMMAND

When the HOW option is selected, PC Plus displays the list of parameters mentioned in the goal list of frames whose values have been inferred using the consequent rules. PC Plus does not display the list of parameters which are mentioned in the goal list but are used to fire the antecedent rules. These parameters are included in the REVIEW parameters list. The student can select a particular parameter to ask how this parameter has acquired its value. In response, PC Plus will quote the rule(s) which was(were) used to infer the value of the parameter. Thus if the student asks how the value of the parameter ASKQ1.1 has been determined by using the HOW command, PC Plus would display:

```
      -ASKQ1.1
        Determined to be YES:  ...  by using Rule019
        If   Reply to the question:
             Which side of the road should pedestrians walk if
             there is no footpath or pavement along the road?
             is RIGHT-SIDE,
        then 1) inform the user of this decision, and
             2) it is definite (100%) that score equals
             [ 1 plus score ], and
             3) it is definite (100%) that ASKQ1.1.
      ** End - RETURN/ENTER to continue
```

The correct answer to this question is RIGHT-SIDE. It is evident from the above response to HOW that this command may also disclose correct answers to the student.

One way to overcome this difficulty might be the association of a property with each rules. Setting it to NO should prevent the system from quoting the rules when the HOW command is used.

Another way of tackling this problem has been used in the development of our TUTOR: namely the use of a forward chaining implementation of the questions or parameters to be hidden from the student.

CONCLUSIONS AND SUGGESTIONS

In general, PC Plus provides a suitable environment for the development of a CAI system like the 'British Highway Code' tutor, using backward chaining, forward chaining or both backward and forward chaining rules. Many of the difficulties that a CAI developer may face could be resolved by making use of the open architecture of Personal Consultant Plus system to incorporate user defined functions coded in Scheme LISP, and of the provision of the meta-language facilities.

For the development of CAI systems like the 'British Highway Code' tutor an expert-system development tool which allows the incorporation of graphics in knowledge bases and which permits the incorporation of custom built sentences for explanation facilities will be the better choice. In some cases, WHY and HOW commands may create some problems like that of disclosing the correct answers to a cunning student. In the case of PC Plus this could be prevented by using the forward chaining approach for the implementation of CAI systems. In general, this could be prevented by providing a mechanism to allow a developer to mark desired parameters nonlistable by WHY and HOW commands.

CURRICULUM KNOWLEDGE BASES (CKB's)

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Abstract

This paper introduces a heuristically based model for the development of curriculum knowledge bases (CKBs). It is the result of an examination and synthesis of over 500 recent articles, books and reports on expert systems, knowledge based systems, knowledge aquisition systems and intelligent computing systems against tasks associated with curriculum development and modification at the community college level. Preparing a CKB is an iterative process of refining a collection of semi-autonomous expert knowledge systems produced by different individuals. Individuals involved in the preparation and development of a CKB include faculty, staff, administrators, students and community members. Hereafter these individuals are referred to as designers. A CKB is a knowledge base which contains both a specific curriculum plan and the heuristics or rationale associated with it. Curriculum in this context is defined as a master plan for selecting content and organizing learning experiences for the purpose of changing and developing learners' behaviors and insights. (Armstrong, D.G. 1989)

This paper examines what should be included in a community college curriculum knowledge base generator. Literature examination suggests that curriculum knowledge bases are possible. The model suggests that CKB generators can be developed and proposes they be designed around existing curriculum adoption methods. Designers of knowledge base tools may want to examine, consider and prioritize a variety of problem domains associated with the production opportunities as CKB tools come into practical reality.

Curriculum development background

The process of planning, curriculum development and decision making at the community college level has historically emerged from conceptualization to implementation by involving a variety of individuals and advisory committees. Individuals and advisory groups design and maintain the curriculum. No two colleges have exactly the same mixture of faculty, staff, administrators, students or community advisers who design the curriculum. No two communities have the same training needs and therefore curriculum designers in different communities possess and employ different expertise and knowledge when designing the curriculum. Yet, in spite of the differences, designers at community colleges constantly analyze proposals related to new training workshops, new training courses or entirely new programs of study or the modification of existing ones. Analyses are formally initiated by someone preparing a written proposal. Written proposals however require extensive time commitments from individuals who represent different knowledge domains. Often the process is iterative as proposals are returned for refinement or clarification. Proposals that become implemented typically contain only skeletal information and the names of concurring individuals or bodies. Concurring rationale is seldom included. This can make future curriculum modification and

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comparative evaluation difficult. There is nothing inherently wrong with this labor intensive process, but, as larger numbers of proposals are introduced and large number of existing implementations seek modification the process becomes very expensive. Can expert system technologies be brought to bear on this problem?

Expert systems and Knowledge acquisition

It is clear that existing expert systems can solve a variety of knowledge intensive problems. It is also clear their development has historically been time-consuming and for many applications has required individuals with very high skills in knowledge acquisition and knowledge representation. An additional problem has been the difficulty in updating and maintaining knowledge systems. Manual meta-knowledge elicitation and extraction techniques emerged early with repetory grids (Kelly, 1955). Shells and subsequent automated knowledge elicitation and extraction tools have recently gained favor including the current use of cognitive emulation strategies (Kidd, 1987)(Hart, 1986)(Slatter, 1987). The result has been an explosion in singular application knowledge systems and a spiraling improvement in the capabilities of automated knowledge extraction tools.

Categories of Knowledge Extraction Tools

Automated knowledge elicitation and extraction tools have started to emerge into categories. A category of automated interviewing tools such as TEIRESIAS (Davis & Lenat, 1982), ETS (Boose, 1987), MORE (Kahn, Nowlan & McDermott, 1985), MOLE (Eshelman, Ehret, McDermott & Tan, 1987) and SALT(Marcus, 1987) focus on the domain expert by presupposing the problem solving method on the expert systems they generate. SALT (Marcus, 1987) has the additional capability of being able to construct a solution to a particular problem from scratch. These are singular knowledge base generator domain systems. A second category of automated knowledge acquisition tools include OPAL (Mussen, Fagan, Coombs & Schortliffe, 1987) and STUDENT (Gale, 1987). These systems attempt to exploit a specific domain model and are also singular domain knowledge base generators. Neither of these categories is currently suitable for the entire process associated with taking a curriculum proposal and submitting it through a series of expert designers analysis and refinement. This does not restrict expert designers from using them for other applications.

System features needed to generate a successful CKB

Selected system features needed for CKB knowledge elicitation and extraction include:

a. No knowledge engineering skills needed to operate system.
b. Ease of entering proposal information and editing concepts, strategies and heuristics with minimum training. Keyboard or voice input.
c. Capability to exploit domain knowledge of designers during knowledge acquisition such as automatic generation of understanding through questioning elicited from domain knowledge.
d. The capability of generating quasi-autonomous knowledge bases which can represent expertise found in curriculum designers.
e. Capability of generating reports to other designers for review.
f. The capability of a designer to access existing local or remote data bases in order to transfer or receive text, graphic and other data into their design input.

g. Glossary generator for terms and concepts.
h. Capability of operating on a local area network.
i. Conflict resolution announcers and conflict resolution strategy invocators.
j. The capability of generating an audit trail.
k. The capability of engaging one or more consulting experts in the process of refining an autonomous knowledge base.

Multiple designer expert system generator

The only existing multiple designer expert system generator identified to date which has gone into the evaluation phase is KNACK (Klinker et.al, 1987)(Klinker et. al. 1988). The KNACK system incorporates features "a" through "d" and "i" in the previous list.

The KNACK system operates on the assumption that a problem to be solved can be written down and that no single person possesses all the knowledge needed to solve the described problem. Any person employing simple text editing skills can enter the problem. KNACK proceeds to act on the inputted information by organizing the input into fragments corresponding to paragraphs. KNACK then builds a general initial understanding of the problem domain and generates a report called a WRINGER. A WRINGER is a suboptimal expert system produced as a consequence of a KNACK interview with a designer. After an initial interview different expert designers address and contribute their knowledge to the solution of the problem and produce additional WRINGERs. WRINGERs become refined and optimized over the process and their collective development ultimately results in a successful design or one that must be rejected. (Klinker et. al, 1988)

A multiple designer system such as KNACK serves as a clear precursor for emergence of curriculum knowledge base development. It is argued therefore that since KNACK exists and since the ongoing focus of research on its formalisms and constructs continue to make it independent of the need for knowledge engineering skills, that extensions to and employment of newer multiple designer systems will emerge. Important questions exist as to what should be included as possible domain areas and how the actual process occur.

Domain areas likely to be included in a CKB development process

Various knowledge domains will be needed to prepare or modify a curriculum knowledge base. Not every domain will have to be exposed to a particular CKB development process. In fact, at the community college level it is likely that proposals will follow academic, vocational and continuing education domain needs. The process of building a CKB calls for a person such as a teacher or even a community member who wants to offer a workshop to create a formal proposal. The proposal is then electronically routed through and to individuals or groups responsible for applicable major knowledge domains. As each domain expert receives the proposal he or she acts on the domain knowledge presented and offers concurrence to or against the plan.

Possible major domain areas of a CKB

The following are a sample of the major domain areas that may involve design experts as they design a curriculum knowledge base: **Mission compliance; Community training needs; Accrediting requirements; Policy conflicts; Budget impact; Resource support allocations; Articulation agreements; Scheduling constraints; Instructional delivery systems; Faculty concerns; Facility impact; Professional directions; Evaluation; Assessment and institutional liabilities.** Not all areas are presented above and the exclusion of an area does not imply it is not important.

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COMPUTER BASED TRAINING IN THE UNITED KINGDOM

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ABSTRACT

For some time now Government has sought to encourage employers to invest in the continuous training of their workforces in the pursuit of higher productivity and quality. Employers in small and medium sized enterprises contend, however, that they cannot afford the release of staff away from the workplace. It is likely that computer based training (CBT) could lessen these difficulties but employers need assurances that it is an effective and economical alternative to conventional training. It is somewhat paradoxical that despite there being little empirical research into the effectiveness of CBT, many larger industries have identified and established CBT as a major training aid. If this confidence is to extend to the smaller enterprises the effectiveness of CBT must be evidenced.

TRAINING NEEDS SURVEYS

Two surveys illustrate the training needs of British industrial and commercial enterprises. In the first, the Institute of Manpower Studies (ref 1) approached 1650 manufacturers and distributors to investigate the impact of new technology in their working practices. They found that there have been significant changes since 1980 in approximately 80 per cent of the organisations; with large scale changes in approximately 25 per cent of them. The main areas affected were production processes, storage organisation and office administration. A variety of occupational sectors were reckoned to require new technology skills training including technicians, supervisors and operatives.

In the second smaller survey, the Northern Ireland Training Authority, NITA (ref 2) investigated the impact of new technology on 92 companies working in Northern Ireland. Although ninety per cent of the respondents acknowledged the effect of new technology in improving product quality and in boosting their competitiveness, the survey revealed that the actual rate of production was hampered by problems in recruiting suitably trained personnel. The problem was most acute for engineers and scientists with less acute but nonetheless serious vacancies for craftspeople and production operatives. This is not a localised problem and similar studies carried out by the Manpower Services Commission (ref 3) have also drawn attention to similar problems in the recruitment of technologists and engineers in the south-

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east of England, for example. In their survey NITA found that for every 100 engineers and scientists employed, two vacancies remained unfilled. Forecasts indicated that the problem would worsen to five vacancies per 100 in 1990.

The skills most in demand were associated with computerised operations. Employers expressed a need for employees to have wider knowledge of computer applications including computer numerical control (CNC) and programmable logic control (PLC). Other skills in demand included the areas of advanced inspection and maintenance with multi-skilled personnel. The pattern for the future it was forecast, would be a continuing rise to prominence of workplace skills associated with materials and equipment handling technologies.

Skill shortages were identified by all sectors of industry but the problems were perceived to be more acute for employers outside of the main urban areas due to the high cost of training sources. The concept of on-site individualised training materials is not new yet NITA registered a lack of awareness, amongst employers, of what materials were available. The impact of the Open College, modelled largely on the distance learning experience of the widely regarded Open University, is still to be felt in this area and may well prove a boon to the small companies in training needs terms.

The survey also highlighted concerns about the quality of training resources in new technology applications. Employers reported difficulties in finding either conventional training sources or CBT packages to meet in-house needs. Costs for tailor-made courseware were judged to be prohibitive for the smaller enterprises (the majority) and those companies which had taken this route, expressed dissatisfaction with the services of courseware houses.

CBT IN THE UK

As might be expected computer based training is used in a variety of industrial and commercial settings in the UK. Barker and Yeates (ref 4) and the Manpower Services Commission, MSC (ref 5) have found that CBT has been making in-roads into the training provision of the military services and the manufacturing, construction (design) and service industries. Buciak (ref 6) found that it was being used not just for basic and procedural skills training but also for the less clearly defined skills of management.

The growth of CBT is illustrated by two MSC reports. In the first, in 1981 (ref 7), they found that only six of the companies approached in their survey were using CBT (all six being computer companies) and a further 11 companies were considering it. Only a year later the second survey (ref 5) showed that a further 18 companies have taken up the techniques. In the main, however, the UK experience is that it is the larger groups who are endorsing CBT. British Gas, for example, (ref 8) has introduced CBT into its 12 training departments for its 100,000 employees. CBT has been chosen for 'traditional' areas of training such as codes of practice and clerical and financial procedures as well as for decision making simulations for management training.

The Manpower Services Commission (ref 9) employs 20,000 people throughout the UK and since 1982 have adopted a CBT complement to their training with courseware materials, generated in-house using the Pilot authoring language. Another large employer Provident Financial Group, as a result of a thirty per cent turnover problem amongst the 1500 local managers in its Personal Credit subsidiary, has employed CBT techniques to improve the selection skills of its personnel management groups. CBT based on interactive video has been at the centre of a major training drive undertaken by Shell UK (ref 10) in an effort to improve accident prevention awareness amongst its off-shore oil well operatives. In a three month period 750 employees used the packages "with enthusiasm" and Shell management felt that it had been a cheaper method than conventional training which would have incurred the expense of transport and substitution of oil-platform workers.

CBT EFFECTIVENESS

In the last example Shell management expressed the view that CBT was cheaper than conventional methods. The view is tenable given the likely level of costs of conventional training in that context but the question which is not addressed is whether or not CBT is actually better than conventional training. Does CBT achieve the same objectives as conventional training methods in less time and at less cost?

Even on the basis of costing, doubts are often cast on the value of CBT. Patrick (ref 11) asserts that in many studies which appear to support the advantages of CBT, insufficient account is taken of such cost factors as the design and development of the materials, delivery system provision, supervision and maintenance and the trainee costs in terms of trainee time and salary. It is precisely these types of costs which are so often underestimated both in the development of courseware and in evaluative studies of CBT usage. It is also these costs which are the most onerous for small and medium enterprises but which are relatively easily sustained by large corporations. In the latter organisations, *per capita* costs tend to be substantially reduced for the larger employee populations and other delivery costs are reduced through the existence of established training procedures and the 'piggybacking' of courseware on existing hardware.

For CBT to develop from its current almost novelty value for UK personnel and training managers, into a committed and widespread training tool a number of issues must be addressed. Firstly rigorous evaluative appraisals of CBT effectiveness must be undertaken and reported in relatively non-academic but valid terminology. Empirical studies using control and experimental groups are not the complete answer. Cost factors need to be accurately identified and compared to conventional methods and participant attitudes must be assessed. Transfer of skills to the workplace must also be established and proven

Secondly some form of centralised guidance, particularly for small and medium sized enterprises, must be provided. Guidance on selection criteria for 'off-the-shelf' packages is needed as is advice on the commissioning of tailor-made packages. The in-house development of materials is fraught with problems and again some type of centralised support is necessary.

Finally there is perhaps one factor above all of the others which could contribute to a more successful and widespread adoption of CBT and that is communication. Employers, personnel and training managers are often bemused by the almost evangelical yet technical marketing of CBT. There is an overriding need to make CBT more accessible to these decision makers and it is up to CBT exponents to communicate their wares and benefits in less technical, down-to-earth ways.

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RESULTS OF A TWO YEAR STUDY OF THE EFFECTIVENESS OF A CAMPUS-WIDE ELECTRONIC INFORMATION SYSTEM

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ABSTRACT

The purpose of this study was to determine the factors in the design and implementation of a campus-wide electronic information system that influenced its acceptance or rejection by the university community. The information system was opened to the user community in January, 1987. Two surveys were administered to users one after three months of system availability and the other after 15 months of system availability. Results of these surveys and usage patterns on the system are examined. Overall results indicate widespread user satisfaction with the system with 82% of the survey respondents satisfied with the system. Usage patterns have also shown widespread acceptance with over 5700 people having opened accounts out of a possible 7000.

INTRODUCTION

The campus-wide information system was developed on an IBM 4381 (the Network Server) to provide improved communication among people and also to provide easy and efficient access to computer resources utilizing the campus digital PBX. The system requirements based on Lehigh's Request for Proposals (ref. 1) were electronic mail, text processing, bulletin boards, conferencing, scheduling, on-line request forms, electronic surveys, and external network access. Training requirements were minimized by designing two menu-driven interfaces that allowed users to learn by doing rather than having to read cumbersome training manuals or attend extensive training classes (ref. 2). The need to provide a consistent user interface based on screen presentation, keyboard definitions, and screen to screen navigation was stressed throughout the design and developmental phases of the project (ref. 3). The two interfaces were a microcomputer based interface which provided quick and easy access to other computers, and an interface on the IBM 4381 called LUNA (Lehigh University Network Applications).

The information system was based on a digital PBX for data communications with speeds up to 19,200 bits per second; low cost personal computers to act as intelligent work stations; and a mainframe computer to act as an information server. Key to Lehigh's implementation strategy was the distribution of MS-DOS compatible microcomputers to all of its faculty and the availability of data connections in all offices, classrooms, and student housing.

RESEARCH DESIGN

The evaluation of the system was done using all current users as the sample. The system was initially developed and tested using a pilot group consisting mainly of faculty and staff. The pilot group was used to test the user satisfaction survey used in this study and also to provide feedback on the design of the system.

The satisfaction survey was based on an instrument initially developed by Pearson to test user satisfaction with information systems (ref. 4). The survey was administered on-line and consisted of demographic questions and 22 system attribute items designed to measure user satisfaction. The satisfaction attributes were combined to create a single normalized user satisfaction score. Attributes were also examined on an individual basis

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to determine those most needing improvement. Internal comparison groups were used to measure differences in satisfaction by gender, campus affiliation, campus status, and computer experience. System usage was also examined as a surrogate measure of system success, since usage of the system was entirely voluntary (ref. 5).

USER SATISFACTION

User satisfaction with the information system was measured by creating a normalized user satisfaction score with -1, extremely dissatisfied and +1, extremely satisfied. Figure 1 shows the satisfaction distribution of users from the May 1988 survey when scores are collapsed into seven equal categories. Over 82% of the 803 respondents were satisfied with the system. This is an improvement from the May 1987 survey which indicated that 77% of the respondents were satisfied with the system.

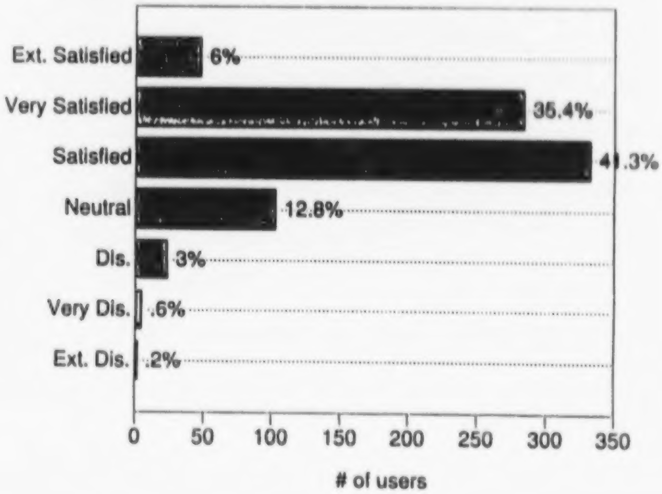

Figure 1:
User Satisfaction
Distribution
(5/88 survey)

Significant differences were found when examining user satisfaction as related to gender, campus affiliation, campus status, and computer experience. These results were demonstrated in both the 1987 (ref. 6) and 1988 surveys. Results from the 1988 survey will be reported here. Females were found to be significantly more satisfied than males (F=48.4095, p=.0000, df=1). The mean satisfaction score on a scale from -1, extremely dissatisfied to +1, extremely satisfied was .4580 for females while that for males was .3229. Users associated with administrative and other non-academic departments were significantly more satisfied than were users associated with academic departments (F=6.5407, p=.0119, df=5). The mean satisfaction score for users associated with administrative and other non-academic departments was .4357 while that for users associated with academic departments was .3494. Support staff were found to be significantly more satisfied with the information system than were faculty, students, or professional staff (F=7.6308, p=.0000, df=4). The support staff had a mean satisfaction score of .4928 while the professional staff, students, and faculty had a mean satisfaction score of .3497 with faculty having the lowest mean satisfaction score of .2991. Users with 5 or more years of computer experience were significantly less satisfied with the information systems than were less experienced users (F=7.6049, p=.0001, df=3). The mean scores of users with less than 1 year experience, 1 to 2 years experience, 3 to 4 years experience, and 5 or more years experience were .3982, .4265, .3915, and .3221, respectively.

SATISFACTION ATTRIBUTE ANALYSIS

Twenty-two satisfaction attributes were selected for the 1988 survey based on results of the 1987 survey. Each attribute was measured by using two bi-polar adjectives and a weighting factor. For example, the question pertaining to the response time attribute was:

Response time of the Network Server
slow (1)_________________(7) fast
inconsistent (1)_________________(7) consistent
To me this factor is
unimportant (1)_________________(7) important

The five attributes with which users were most satisfied were: the ease of use of the mail facility, the format of the Network Server screens, the ease of use of the Bulletin Board facility, the ease of use of the Information and Services facility, and the accuracy of the Network Server information. The high scores on four out of five of these attributes indicates that users are generally satisfied with the menu driven approach to using the Network Server. Pearson and Ives also found that accuracy of information was very important to user satisfaction with information systems (ref. 4 & 5).

To determine the attributes that needed the most improvement, the mean raw satisfaction score was compared with the mean raw weighted score. This method was used rather than using the attributes which had the least user satisfaction, since the low satisfaction scores could have been caused by people rating the variable very low and being neutral in response to the adjective pairs relating to that item. The five attributes most in need of improvement were: response time, Computing Center attitude, Network Server training, Computing Center competence, and Network Server flexibility. It should be noted that all attributes improved in the 1988 survey when compared with the 1987 survey results with the exception of response time.

SYSTEM USAGE

The system was opened to the Lehigh campus of 7000 possible users on January 14, 1987. Individual users opened accounts on the Network Server on-line from anywhere on-campus by using information on their university ID cards. The number of accounts by the end of the Spring semester was over 2000 or 30% of the possible user base. By the third week of the fall 1987 semester, there were over 3500 accounts on the system. On Feb 4, 1988 there were over 4800 accounts opened with an average of 2200 logins per day. Figure 2 illustrates the growth pattern for accounts on the system from December 1986 to September 1988 with over 5700 accounts or 81% of the possible user base.

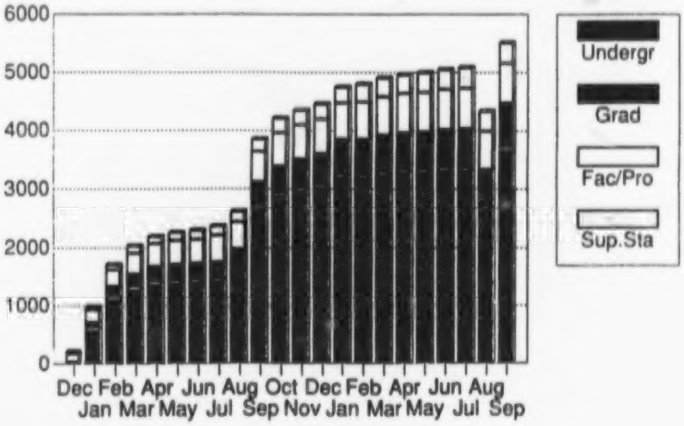

Figure 2:
Account Growth
12/86 to 9/88

The most frequently used facilities were electronic mail and the Information and Services facility. Over 250 topics have been introduced under Information and Services; the key to its rapid growth is that each topic is maintained by the individual, department, or group for which the topic exists. For example,

- The Library maintains a series of on-line forms, including ones for interlibrary loan, reference questions, bibliographic searches, and media center requests.
- The Registrar's Office maintains searchable text files consisting of course offerings and final exam schedules.
- The Research Development Office maintains a bulletin board of research funding opportunities.
- The Computing Center maintains electronic libraries of public domain and site-licensed microcomputer software.
- The Computing Center also maintains a public bulletin board area for posting of messages of general interest, such as rides, housing, and items lost, found or for sale.
- Faculty can use a roster application to obtain electronic mailing lists for the students in their classes.
- An on-line survey facility allows for the creation and administration of electronic surveys to any user or class of users on the Network Server.

KEY DESIGN AND IMPLEMENTATION FACTORS

Below is a list of the key design and implementation factors that the author feels were critical in the initial success of the information system.

- The commitment and risk taking of key administrative personnel at the presidential and vice presidential level to provide computer resources and networking capability to the entire campus.
- The accessibility of microcomputer workstations to faculty and students.
- The development of functional and easy-to-use software.
- The overall design of the Information and Services facility, which distributes the responsibility for maintaining campus-wide information to individuals, departments, and groups.
- The early users of the information system, such as the Research Office and the Library, who were instrumental in its design. These early users helped to interest other users and create what is now a critical mass of users, necessary for the success of a campus-wide information system.

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TEACHING INFORMATION TECHNOLOGY COURSES TO ARTS UNDERGRADUATES: A DESCRIPTION AND ANALYSIS

Audrey Croucher*

ABSTRACT

One of the first projects to be funded by the University Grants Committee under its Computers in Teaching Initiative, whose purpose was to introduce computers into areas of the university curriculum where they were not already established, was Project Pallas at the University of Exeter. Its brief was to provide good access to computing amongst staff and undergraduates in the Faculty of Arts. This paper describes, first, the content and scope of the courses which were taught, followed by an analysis of the lessons which have been learned from the teaching. Although all comments refer to the first three years of the project, 1984-1987, Project Pallas continues to flourish. It is both a popular and expanding facility within the Faculty of Arts.

INTRODUCTION

Project Pallas, the Computers in Teaching Initiative project at the University of Exeter, funded by the Computer Board of the University Grants Committee, was initiated to encourage open access to computing facilities for all staff and undergraduates in the Faculty of Arts. This included about one hundred and seventy staff and a thousand students in twelve departments; namely, Arabic, Classics, English, French and Italian, German, History and Archaeology, Music, Philosophy, Russian, Spanish and Theology.

In the early days of the project there was much debate, fuelled by the arrival of the hardware, as to what constituted appropriate course content. On the one hand a fairly narrow academic content would closely ally content to the subject course of which the computing was part. Alternatively, it was argued that a more general course, relating to the use of computing in academic and commercial contexts would be more suitable for students who, after leaving university, would go to a variety of jobs.

The initial thrust of teaching, in order to support open access for all, following the start of the Project in December 1984, was to introduce as many users as expressed interest, to general computing applications for arts subjects, notably to word processing and database work, through voluntarily attended introduction to computing courses. These proved very popular and by the end of the academic year three hundred students had been taught. Although these courses continued to be offered, starting with the first full academic year, 1985-86 and thereafter, the emphasis of the teaching changed considerably. The result was courses which were strongly academic, which emphasised applications of information technology within specific subjects and, which taught coincidentally, general transferable skills.

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By the end of the Trinity Term 1986, the first full academic year of teaching, seven hundred and eighty three people had had some exposure to information technology. Some users had attended a course which was only a hour long, others had attended more than one course. The majority (82%) of attendees were undergraduates. Of these, three hundred and eighty four or 60% came on subject courses. The rest attended a Faculty wide introductory or word processing course organised for a subject group.

DESCRIPTION OF THE COURSES

The introductory courses comprised two half day sessions, on an introduction to computers, keyboarding and word processing and on databases and their applications.

The subject courses were distinguished by the variety of computer application and by the large number of departments which used the facilities. Table 1 shows that thirty seven courses were taught, incorporating a number of different subjects, and including computing applications which ranged from word processing to programming.

Table 1: Summary of subject courses taught, 1985-86

	Subject	No of courses	No of hours	No of students	Course
Michaelmas Term 1985	Archaeology	2	27	22	PM
	Classics	2	5	17	DB
	French	1	8	8	WPDB
	History	4	18	122	WPDBST
	Italian	2	9	20	DBTA
	Language Centre	1	5	6	C
	Library	1	8	8	G
	Linguistics	1	6	6	P
	Philosophy	3	30	18	C
Lent Term 1986	Archaeology	1	10	10	WPDB
	Classics	1	2	10	DB
	French	1	1	9	DB
	History	2	12	16	DB
	Italian	4	14	25	DBTA
	Language Centre	2	20	20	C
	Linguistics	1	2	-	P
	Library	1	2	6	G
	Philosophy	5	20	34	C
Trinity Term 1986	Linguistics	1	2	5	P
	Language Centre	1	20	10	C
Total		37	221	372	

C - computer assisted learning
G - general programming
PM - principles and methods
TA - text analysis
DB - databases
P - programming
ST - statistics
WP - word processing

SOME LESSONS

For both staff and students the introduction of information technology into the curriculum demanded non traditional approaches to learning. Many relevant issues concerning organisation and management arose (ref 1).

Classroom Design

When the classroom was designed high student demand for courses was anticipated and a layout was chosen which accommodated the maximum number of students (fourteen) in the space. This resulted in a traditional design, with all work stations facing the front. Heavy use of the room has underlined its inefficiency.

Organisation of Teaching

Throughout the Project, and especially when attendance was voluntary, courses had to be devised which were both attractive to students and educationally sound. The main issue, apart from content, was timetabling. The duration of classes needed to be long enough to achieve a positive outcome but short enough for interest and concentration to be retained. Two hour sessions have proved satisfactory both for effective learning and attendance. Courses which had a high number of shorter sessions were unsatisfactorily attended towards the end, owing to the intrusion of other compulsory commitments.

Teaching Methods and Documentation

Most students, at the beginning of a computing course, felt deskilled compared with their existing academic competence. Tangible achievement in the first session was essential. It was helpful too if homogeneous students, preferably those who knew each other, were grouped together. All first years from specified subjects such as history, theology, American Arts and German, attended a compulsory word processing course. Each group created its own atmosphere of camaraderie and mutual help. An important factor in developing this camaraderie was the immediate introduction of "hands on" experience, perhaps best achieved by use of a self teaching typing tutor program, which also prevented most students from developing anticipatory tension.

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1 Detailed discussion of the issues raised in this section is contained in two previously published papers:
1. A Croucher, Learning Computer Lessons at Exeter, Computer Education 58, February 1988, 19-20.
2. A Croucher, Teaching Computer Courses in the Arts Faculty at Exeter, Computer Education 59, June 1988, 30-31.

At first, owing to time constraints and student numbers, teaching sessions were broken into a series of short demonstrations and practicals. The outcome of this "staccato" style, which was partly determined too by the classroom layout, was often mechanical copying of what was displayed on the overhead monitors, little real understanding and over dependence on memory and the teacher.

However, taught courses were less than satisfactory for some students. Competent students wasted time waiting for the rest of the class while students who were least familiar with computers required more time on basics. There were problems, too, with practice and forgetting. Taught courses were not flexible enough to cope with users who returned to computing weeks after initially learning the system. For these reasons, later instruction, especially for word processing, deliberately, closely followed prepared documentation. For word processing students received two specially written, site specific, manuals. In this way learning became less of a memory test and more fun (which was not unimportant).

The final session of most courses, and every word processing course, was devoted to supervised practice. Students brought their own work and proceeded with it while advice was available if needed. This personalised the learning and gave students a head start with their first individual piece of work. It resulted in more confident and competent users.

Accessibility of the workroom and staff

Students have use of the workroom twenty four hours a day, three hundred and sixty five days a year and all have recourse to advice from staff throughout the working week.

Survey results indicated that the high number of users was attributable in part to the accessibility of hardware but mostly it was availability of staff help which made the use of the facilities attractive. The key to success lay in regarding advisory help as an integral part of teaching. Consistent with the policy of open access, staff have been scrupulous in always being prepared, within reason, to offer immediate help.

CONCLUSIONS

During the course of the project hundreds of students have been introduced, relatively painlessly, to computing skills with which they could improve their university work and their career prospects. Success has hinged on the combined forces of an intensive teaching program reinforced by readily available advisory help.

THE BEGINNING TEACHER COMPUTER NETWORK: SUPPORTING THE TEACHING INDUCTION PROCESS

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ABSTRACT

The Beginning Teacher Computer Network at Harvard linked thirty-eight beginning teachers via personal computers and telephone lines during their first year in the classroom. Participants were all graduates of Harvard teacher training programs. Members discussed a wide variety of teaching issues and educational philosophy. At the end of the school year, members responded to a survey rating the Network's effectiveness on several objectives. Ranked highest were the Network's ability to provide support throughout the first year of teaching, and to provide a broader perspective on teaching and education.

INTRODUCTION

Interactive technology and computer mediated communication have been areas of active research for the past decade. Their application to educational settings provides new alternatives for addressing old problems of teacher training and induction. It is a well-documented principle that those teachers who are engaged in a collegial exchange with peers are most likely to improve their teaching practices. However, new teachers often perceive their first year in the classroom as a time of isolation. The compartmentalized structure of schools often inhibit this kind of interaction among colleagues. Geographic dispersal of teachers make it difficult for teacher preparation programs to maintain close contact with their graduates, and for teachers themselves to establish contact with their colleagues in other schools and programs. Computer network technology provides a new medium for beginning teachers to make these connections in order to continue the process of learning to teach on the job.

THE PILOT STUDY

The Beginning Teacher Network was implemented by Harvard Graduate School of Education in 1987-88 in order to continue training and support efforts of its teacher education programs. Linked by personal computers via telephone lines to each other, to veteran teachers, and to Harvard faculty members, thirty-eight beginning teachers participated in discussions on classroom practice, curriculum development, and educational philosophy. These new teachers, all 1987 graduates from three teacher training programs at Harvard, used personal computers in their homes or schools to log on to the Network. Each member knew about one-half of the other members prior to joining the Network. Participation was

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voluntary, and computers and modems were loaned to those members who did not own hardware. Telephone costs were paid for by a foundation grant.

The Network was dedicated exclusively to the university-based induction program efforts. The host was a single personal computer utilizing conferencing software, Common Ground, designed especially for small networks by the Educational Technology Center at Harvard. Members sent and received private messages and publicly discussed topics relating to their teaching experiences. Network discussions covered a wide variety of topics. For example, participants received teaching advice specific to a particular subject area, such as mathematics or foreign languages, discussed questions about evaluation and classroom management, and received concrete suggestions on the organization of classrooms and lessons. Conversations ranged from pedagogical questions to the purposes and effects of education. In some instances, participants presented case descriptions about their teaching or school sites for reaction and counsel. Over four thousand messages were sent during the 1987-88 academic year.

At the end of the academic year, participants responded to a survey exploring their use of the system and their perceptions of its effectiveness in meeting the needs of beginning teachers. The survey responses were used to study the ratings of network effectiveness against background variables, such as frequency of participation, subjects taught and prior experience with computers. Participants also were asked to comment on particularly effective discussions and the technical workings of the Network. Thirty-two of the thirty-eight members (84 percent) responded.

RESULTS

Computer networking has a fairly broad base of research that centers on the use of networks to link students and teachers to advance educational goals in the classroom (ref 1, 2, 3). While none of the studies report directly about computer networks dedicated exclusively to the support of beginning teachers, they do provide a valuable frame of reference for exploring the effectiveness of this Network.

Because of the technical foundations, networks often are perceived as a medium to transfer concrete bits of information. In this instance, such information would be represented by lesson plans, curriculum units, book titles, and other materials resources. A proposal to establish a computer network for beginning teachers in California illustrates this common assumption, suggesting a proposed electronic network will provide "information and skills training" (ref 4). Other research on computer networks found that network members ranked "obtaining specific information" as one of the two highest rated services of the network being studied (ref 3).

A second common assumption about networks is that they will be used primarily to communicate socially with friends and colleagues. Katz et al. (ref 3) noted that participants on the science teachers network highly ranked "communicating with colleagues" while Riel suggests technical motives are more compelling than substance: "It is the ability to send and receive information and not the content of the exchange that is the center of focus" (ref 1).

Survey responses from Network members yielded some very interesting findings relative to these commonly perceived purposes and capabilities of networks. With the Beginning Teacher Computer Network (BTCN) dedicated exclusively to the support of beginning teachers, the objective of transmitting concrete knowledge or obtaining specific information was not highly ranked. Members judged the Network only moderately effective in assisting with curriculum and lesson planning (a mean of 2.89 on a 7 point scale; 7 is most effective), classroom management (mean=4.42), and exchanging teaching techniques (mean=4.68), well below four other objectives. Beginning teachers did use the network to transmit concrete information about textbooks, lesson plans or curriculum, but not to the extent that they did for receiving (and giving) support to fellow first year teachers (mean=5.78), getting a broader perspective on education issues (mean=5.61), keeping in touch with friends from their teacher training program (mean=5.21), and reflecting on philosophy of education (mean=4.92). The most frequent users (those who reported using the Network ("almost daily") rated the Network most effective in providing a broader perspective on educational issues, providing the opportunity to reflect on educational philosophy, and providing moral support. The survey responses indicate that participants focussed clearly on the content of the messages. Keeping in touch with friends, a tempting objective for a group who knew well over half of the other participants through course work at the university, was ranked lower than discussion of issues of teaching.

DISCUSSION

Members' ratings of the Network's effectiveness in meeting the needs of beginning teachers generate new perspectives and goals for interactive computer networking and for teacher education programs. The finding that new teachers perceived the Network as a tool that fosters reflection about educational issues and broadens one's perspective on teaching, instead of a device for information exchange, suggests that university-based teacher training efforts need not end on graduation day. What is it about the Network that causes its members to go beyond information exchange to the rich discussions and reflections of beginning teachers?

The equal status of nearly all the members causes the Network to resemble a popular staff development model called peer coaching. While peer coaching models often define their purpose as the acquisition of specific teaching skills or behaviors through peer-to-peer consultation and a common commitment to interact and advise each other (ref 5), the Network's goals are broader and include a dedication to improve teachers' thinking about teaching and to enhance the novice's acclimation to the profession. In this regard, Network interactions more closely resemble the staff development model of collegial coaching that helps "teachers make their thinking conscious and refine and expand their decision-making strategies by talking about them to a peer" (ref 6).

Another popular model for teacher induction programs is mentoring, in which an experienced teacher guides a beginning teacher through the first year(s) in the classroom. Because of the public nature of the interactions, the Network affords certain advantages for teacher development that traditional models of peer coaching and mentoring do not. First, rather than a singular coach or mentor being assigned to the beginning teacher, there are many coaches from diverse educational settings. In fact, participants who present a specific teaching scenario for discussion may have as many as eight or ten different individuals contribute to the discussion of the "case". This multiplicity of views offers a richness to the conversations not typically found in singular mentor-mentee relationships. Providing a broader perspective on teaching and education was the objective ranked second in effectiveness of seven Network goals by BTCN participants. Indeed, research about effective mentors suggests that the ability to evaluate a situation from many points of view and explore a variety of options is a characteristic of effective mentors (ref 7).

Computer technology has provided a means for overcoming barriers that restrict the contribution of teacher education institutions to the process of induction of new teachers. Interactive computer networks can link new teachers to each other and to former faculty members in order to provide support and continuing education, reducing the sense of isolation that many beginning teachers experience. The findings of the Beginning Teacher Computer Network suggest rich areas for research on the impact of this medium in fostering reflection about teaching and the continued development of teachers beyond the university.

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USING INFORMATION TECHNOLOGY TO INTEGRATE BUSINESS STUDIES TEACHING

W. Richardson*, G. J. Worsdale°.

ABSTRACT

Over the past two years Sheffield City Polytechnic has collaborated in the IBM Education Project - a project which aims to use Information Technology to improve the productivity of Business Education. The overall aims of the project were first discussed in Richardson and Worsdale (Ref. 1).

A major objective of the project at Sheffield is to enable graduates to perceive that they have completed a programme of related studies which gives a holistic view of organisational policy and decision making.

This paper describes how IT "exercises" are supplementing other inputs to achieve the "integration" objective.

INTRODUCTION

In a business era which demands sophisticated strategic management and teamwork, a group of staff at Sheffield City Polytechnic have been concerned to ensure that they provide students with a holistic perspective of their programmes of study. Lengthy course durations (four years for a sandwich degree and, possibly, six years for a part time degree) and staff inputs from a range of groups/departments tend to work against a holistic perception as does recent moves towards a Credit Accumulation and Transfer award systems.

At Sheffield, therefore, we have introduced a programme to integrate business studies subjects in wuch a way as to emphasise the relationships that exist between the subject areas. Information Technology is seen as an important facilitator in this programme.

INPUTS INTO THE INTEGRATION PROGRAMME

A core stream of integrated subjects

The Business Policy subjects which span the whole length of a course include Functions of Business, Decision Making in Organisations and Corporate Strategy. Thus it is the task of the Business Policy Staff to link and progress these subjects through the duration of the course and, more importantly, they have the primary responsibility for conveying to the student the "fit" of non Business Policy subjects into the quest for improving strategic decision making. Business Policy staff are aided in their integrator role through the following three mechanisms:

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(1) A model describing the organisation as a planning system
(2) Integrative texts
(3) Information Technology

A model describing the organisation as a planning system

This model is presented to the students at regular intervals, it shows the organisation adapting to its environment through a range of overlapping and interactive planning activities. Thus, for example, subjects dealing with business behaviour, quantitative methods, new product development and strategic analysis are undertaken in the context of their contributions to Team Culture Planning, Productivity Planning, Innovation Planning and Corporate Planning and to the ongoing development of business strategy understanding and skill.

Integrative texts

Staff have prepared related texts which provide, on the one hand, the theoretical underpinning of management strategy and the different planning activities which contribute to strategic success (Ref. 2) and, on the other, Case Studies (Ref. 3) which facilitate planning/decision making practise. Both texts are intended to travel with students through the life of their studies - acting as specific subjects sources of help and also as reminders of the comprehensive nature of business policy.

Information technology

Staff have designed and implemented a series of IT "exercises" which aim to both improve competence/confidence in the use of IT equipment and show how IT is fundamental to good decision making and planning.

Thus in the first year students undertake a series of computerised self help tutorials which requires them to answer a sequence of questions on basic material in the areas of organisational structures, marketing, production, personnel and finance and, more importantly, requires them to make comments on the validity of their own answers and those given by the programme. These comments and answers are then used as the focus for the following weeks tutorial with a member of staff. In addition to these self help tutorials the students are required to develop their skills in the use of a spreadsheet for production planning and financial planning. Once again they are required to comment upon their performance and again these give a focus for tutorials with staff. These types of "exercises" are directly linked both to the text and the Case Studies referred to above.

In the second year of the course the Case Studies and the IT "exercises" are even more closely linked with the students being required to undertake productivity ratio analysis, forecasting, sensitivity analysis, stakeholder analysis, etc.

Thus by the time the students reach the final stages of their courses they are competent users of IT equipment and understand the role that IT can play in decision making and planning. They are "natural users" of IT.

IT has thus provided another medium which offers specific decision making assistance but also acts as an habitual learning aid throughout the programme of study.

The final part of the Business Policy course considers through discussion why IT is 'the most important contingency with which organisations have to deal' (Ref. 4) because of its impact, through its different planning applications, on the strategic standing of an enterprise.

CONCLUSION

In an effort to provide a more integrated approach to the teaching of Business Studies, Sheffield City Polytechnic is bringing to the problem a range of integrators. People, books and models are to play their parts but information technology is fundamental to the quest of improving business decision making skills and to instilling in students a more holistic view of strategy making - academically and practically.

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ASSESSING INDUSTRIAL TRAINING EVALUATION METHODS:

Joyce Supina*

ABSTRACT

Training in corporate America is a multi-billion dollar industry. While corporations have invested heavily in the premise that trained employees are more valuable than untrained employees, there are wide variations in evaluation methods used in assessing the outcomes of training. This paper compares the methods used in several major corporations to evaluate management and technical training programs. Interviews with training directors and managers describe the methods in use, the conditions which determine the effectiveness of those measures, and the use of the information for future training and in the organization itself. Results show a broad difference in the levels of evaluation used to assess technical training and those used to assess management development programs.

INTRODUCTION

In today's competitive marketplace, training is industry's first answer to productivity and competency questions and a typical approach to solving human relations and supervision problems in management. As the panacea for both manufacturing and management, training has as its goal " making sure the right people learn the right thing at the right time." But how are those outcomes of training being defined by industry today? Every day, millions of managers attend workshops and seminars on supervision, communication, human relations, and decision making to improve their management skills. Concurrently, employees whose jobs have technical functions are taught engineering, electronics, and manufacturing techniques, ostensibly to improve their job performance. The purpose of this research is to determine differences, if any, between the levels of evaluation corporations use for assessing the outcomes of technical training and those used for evaluating management training programs.

INSTRUMENTS AND METHODS

Eight corporations were selected to participate in the study, largely on their reputed committment to training and employee development and their use of both management and technical training programs. All participating corporations had more than 25,000 employees, their own in-house training departments and a training manager or director who agreed to a structured interview in which his training evaluation methods would be discussed.

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Validation of the interview survey instrument consisted of a review of five academic experts in the field of training, three corporate training managers, and three pilot interviews. Managers were asked to describe both management and technical program evaluation methods and to provide any forms used to gather information during the assessment process. The interviewer recorded and catagorized data into the following seven evaluation levels:

Reaction:	Did you like it?
Learning:	Did you learn it?
Implementation:	Did you use it?
Effectiveness:	Did it make a difference?
Cost Effectiveness:	Was it worth it?
Repeatability:	Would you do it again?
Analysis:	Are we asking valid questions?

RESULTS AND DISCUSSION

Results of the survey showed marked differences in the levels of evaluation methods used for technical and management training. All managers reported using the first level of evaluation (Did you like it?) in all training courses, reporting the use of a reactionaire to record attitudes of participants. Donald Kirkpatrick, whose evaluation framework suggested the model for this study, includes participant reaction as an important measure of determining the effectiveness of training programs. (Kirkpatrick,"Evaluating Training Programs", ASTD, Madison, Wisconsin, 1975.) He proposes a four stage model of evaluation, Reaction, Learning, Behavior, and Results. The model used in this study expands the information gathered. In the present study evaluation at the second level, Learning, was seen as summative for technical learners and formative for management training. While learners of technical information were always rated by some immediate competency based assessment, managers were rarely asked to demonstrate what was learned, and only two of the eight participating companies described problem solving projects which implemented that training.

At the third level (Did you use it?), training managers were asked if they determined whether the new knowledge was helpful to learners on the job. In technical courses, five corporations reported using some measure of on the job performance to determine both the amount of learning, and the implementation of that learning. For management training however, evaluators typically assumed that training was being used on the job without an attempt to question participants after training had taken place.

Level 4 (Did it make a difference?) evaluation on effectiveness was easily established in technical training programs where output is measured in units manufactured or error rate, but is more ambiguous when measured by employee ratings of management support or opinion surveys several months after training has taken place. Few feedback loops were in place to evaluate the productivity of management training, while technical performance measurement, (time involved in ticket processing or baggage handling, for instance) is usually recorded and available for comparison. Level five, Cost Effectiveness, asks if the cost of training is calculated. Does management measure the cost of training against some perceived benefit? What factors determine if cost effectiveness is measured at all? Managers answering this question unanimously cited the difficulties of attributing cost benefits to management training. Most however, reported bottom line benefits of technical training from measures which were already in place. Level six, the Repeatability, or institutionalization of a training proceedure requires the knowledge that the program is effectively still teaching the "right people the right thing at the right time". Is management asking if the people, the knowledge, or the time have changed? Should the course be taught exactly the same way? Training managers in the study rely mainly on the first three levels of assessment for technical training courses, and depend primarily on the reactions of participants in management training courses. The seventh and last level of evaluation in this study encourages an analysis of the evaluation selection process itself. In attempting to choose the most effective evaluation methods, are the right questions being asked? Does any information received in feedback suggest a change in the mode of data collection? With one exception of a corporation which supported its own center for evaluation and research and regularly taught evaluation techniques to management, the remainder of training managers assessed responses to evaluation at each stage, but not the process itself.

IMPLICATIONS AND QUESTIONS FOR STUDY

The differences in evaluation of programs precipitate new questions about the nature of training and the intent of industry in providing training for its employees. First, one might ask, is there a lack of measures to evaluate the outcomes of management/supervisory training or simply a reluctance to evaluate management? Is the underlying assumption that management training is by nature bound only to formative evaluation techniques and technical training served only by summative methods? Are only management personnel "developed" and only technical personnel "rated"?

Secondly, are corporations morally bound to align training and the evaluation of training outcomes with job performance measures and its appraisal system? Is there an implied contract between the employer and the employee who agrees to undergo training that if he or she becomes a better worker, those efforts will be recognized? If so, what is the obligation of the employer to monitor and measure the effects of performance and productivity?

Third, there are limits to the training role as it typically serves the corporation which prevents it from becoming an effective proactive system. The appraisal process does not include feedback to the trainer, whose role usually ends at the door to his classroom. Training managers are forced to adopt an internal marketing stance to sell the benefits of their department to other managers who may not be accustomed to sharing information.

The answers to these questions will require a critical look at both the practical differences in training and performance evaluation, and the roles of objectives in the evaluation process.

THE EVOLUTION OF A STATEWIDE K-12 NETWORK

P.S. Tinsley*, E. Brumback**, L.K. De Grand**

ABSTRACT

In January 1988, the North Carolina Department of Public Instruction and the TI-IN Network entered into a contract to install a statewide network providing high school instruction and staff development programming to 146 receive sites throughout the state. It represents the largest such statewide initiative in the nation to date and is the first initiative to approach the challenge of providing student and staff programming through this type of partnership.

The evolution of the North Carolina network progressed from a three-site pilot project in 1986 to a 146-site network in 1988. The relationship between North Carolina's Department of Public Instruction and TI-IN has also evolved from one of supplier/consumer to partnership. The history of this endeavor can be traced through the origins of the North Carolina project, the network's installation/implementation process, and future directions from the perspectives of both North Carolina and TI-IN.

BACKGROUND

As in many states in the United States, a variety of challenges are facing North Carolina K-12 education. These include:

- low enrollment classes and teacher shortages
- the need for updating skills of teachers, administrators and support staff on an on-going basis
- a legislative mandate for equity in educational opportunities and services.

As early as 1986 the North Carolina Department of Public Instruction was considering satellite technology as one means of addressing these issues and ran a pilot project at three locations, Roanoke Rapids, Currituck County, and Graham County, providing staff development to teachers via satellite. This project provided six one-hour sessions covering integration of the computer into various content areas of the curriculum.

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Over 90% of the participating teachers considered the pilot project to be an effective way of delivering instruction. Based upon this evaluation and a survey on curricular needs at small rural high schools, a bill was introduced in the 1987 General Assembly for establishment of a statewide satellite network providing both:

- high school instruction to 54 of the smallest and most rural high schools

  and

- staff development programming in each of the state's 100 counties.

NETWORK IMPLEMENTATION

In August 1987 three million dollars was appropriated for this purpose. The funds were to be expended over the course of two years:

- two million dollars in the first year for hardware and installation
- one million dollars in the second year for programming.

Given this timeframe and knowing the high cost of program development in terms of both time and money, the North Carolina Department of Public Instruction (DPI) decided to attempt to identify a producer (or producers) that would be capable of providing some or all of the needed programming. This exploration brought DPI into contact with TI-IN. Following discussions and an evaluation of TI-IN, including a review of TI-IN instructional programming by DPI's Instructional Services Area, DPI entered into a contract with TI-IN for the provision of direct high school instruction via interactive satellite delivery at 53 small rural high schools and 400 hours of staff development programming at 93 additional sites, for a total of 146 receive locations.

Currently over 1000 students are participating in 20 of the courses offered via the TI-IN Network. Enrollments have been concentrated in foreign languages (French, Spanish and Latin), mathematics (trigonometry and calculus), sciences (physics, astronomy, and marine science), psychology/sociology and art history and appreciation.

In addition to TI-IN's 400 hours of staff development programming, DPI has started to add to the staff development programming available to its teachers, administrators and support staff by originating a weekly public education teleconference, uplinked from the state's capital. And it is at this point that it is appropriate to begin considering the transition in the relationship between TI-IN and DPI from that of supplier/consumer to one of partnership. Further, it is an appropriate point at which to begin considering future directions of the relationship.

FUTURE DIRECTIONS

From North Carolina's perspective, it has always been important that the satellite network reflect North Carolina's needs and programming resources. DPI staff have always felt that scheduling of North Carolina produced programming was important in order to generate a sense of "ownership" of the network by all of the state's receive sites.

Happily, this sentiment was both understood and supported by the TI-IN Network. Within the first few months of the relationship, North Carolina was contributing programming for incorporation into the TI-IN 400 hour staff development package (an interactive teleconference on the U.S. Constitution and a session on self-esteem for teachers). Moreover, assisted by TI-IN's contribution of satellite time, DPI began its own origination with the one hour weekly interactive teleconference described above.

This partnership has now been expanded and formalized by North Carolina's participation in the TI-IN United Star Network, a six-state consortium, formed for the purposes of expanding programming resources and uplink and receive sites. This consortium received start-up funding from the United States' sponsored Star Schools program. Besides adding 17 receive sites to its statewide network under this program, North Carolina is also developing an 18 hour methods course for teaching foreign languages in the elementary grades. This course will assist administrators in meeting North Carolina's legislated mandate to provide second language instruction at the elementary school level.

It can be anticipated that future direction of the North Carolina network and its relationship with TI-IN will have much the same impetus: educational mandates, legislated or community-desired, which can be met by a centralized initiative building upon the network's foundation.

HELLO OUT THERE: ONE SCHOOL'S APPROACH TO DISTANCE LEARNING

C. M. Dowd *

ABSTRACT

Recently, students at Wheatland-Chili Central Schools have participated in several distance learning projects. Models include the AT&T Long Distance Learning Network, Dialog Information Services and TI-IN satellite learning. Through e-mail and on-line data base services, teachers and students have acquired a more global perspective of the world around them. Students gain experience in finding, analyzing, managing and presenting information using the technology they will encounter once they leave the school setting. Distance learning proves to be a leveling force in education - as all students can participate on an equal footing.

INTRODUCTION

In the last two years, thanks to Efficiency Study Grants from the State of New York, commercially funded pilot projects, and the commitment of local funds, Wheatland-Chili School District has expanded its horizons through distance learning. Students and teachers in this Rochester suburb have participated in several projects including AT&T Long Distance Learning Network, Dialog Information Services, TI-IN satellite learning, NASA Spacelink, and Cable X-Change, X-Press. Soon they will also participate in an AppleLink Personal Edition project, join McGraw Hill's MIX network and experiment with a USA TODAY project.

A SATELLITE MODEL

Our school district is the smallest in the metropolitan Rochester area. Our population totals approximately 950 in an area where the tax base is rather narrow. According to New York State law we offer all mandated subjects but can not always provide the enrichment that larger districts can afford. Thus we became a prime candidate to pilot a distance learning project for the State Education Department. After careful study, the services of the Texas-based, private sector satellite programming, the TI-IN Network, were engaged for a two year period. Through the use of audio, video and graphics, a master teacher in Texas conducts classes that are broadcast to multiple sites. The teacher and students interact via two way audio and one way video, and programs may be videotaped for delayed use. The student audio component consists of toll-free access to the studio via cordless phone sets, with the student question/comment heard by all in the viewing area. Electronic mail - homework, handouts, announcements - can be downloaded and printed on the dot matrix printer which is part of the system.

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Although TI-IN's main thrust is basic instruction for schools with small enrollments, Wheatland-Chili's use has been mainly student enrichment, staff development and adult continuing education. Staff development and enrichment classes have brought such names as David Elkind, David Thornburg, Molly and Daniel Watt, James Michener, and Heloise into our school. The ability to tape broadcasts lends flexibility to viewing use (but removes the live interactive component). The recent addition of interactive graphics transmission via graphics tablets located on site adds a new dimensions to this distance learning model.

STUDENT TELECOMMUNICATIONS

In the fall of 1987 our school was one of 100 sites selected to pilot the AT&T Long Distance Learning Network. Currently in its first year as a commercial venture, this telecommunications projects joins students in the US, Canada, Australia, France, West Germany, the Netherlands, and Japan. The learning circle (similar to the quality circle in business) is at the core of the LDLN. Each circle consists of four to seven sites who share common interests but different geographic or cultural backgrounds. "As a pioneering mixture of educational group sharing and information networking, the learning circle structure provides a forum for teachers and their classes to exchange their school and classroom realities with others and to further practice their basic skills in a larger context." (ref 1) Examples of learning circles include Computer Chronicles, Global Exchange, Wellness, Society, Mind Works, and Places and Perspectives.

The most striking result of such a telecommunications project is cooperative learning and writing. Students quickly see that multiple messages on the same topic can be redundant and boring, and the needs of the circle are better met with a few good cooperatively written messages. By exploring creative ways to integrate communication technology into the classroom, our students realize that Wheatland Chili is the not be-all and end-all they thought it was - instead we are a small, but integral part of the whole. Such a project is an excellent way for students and teachers to familiarize themselves with telecommunications as active participants, retrieving, saving, and uploading their work with ease. It also fosters the use of word processing because writing while on line is costly and does not allow for editing. Similar networks for schools to explore include MIX (McGraw Hill Information Exchange) and AppleLink Personal Edition.

INFORMATION RETRIEVAL

No library can serve all the needs of its community and this is especially true of the school setting. While our students have come to rely on interlibrary loan to supplement local resources, the turn around time may be slow and the delivered material not as expected. Our secondary library needs assessment listed the following objectives to be addressed with our students: promote critical thinking skills; develop research skills; formulate search concepts; locate, retrieve, analyze, synthesize and evaluate information; and foster independent searchers and learners.

With this in mind, and the need to give students practice with information retrieval, our high school media center subscribed to Dialog Information Services, bringing over 900 searchable data bases within student reach. The implementation of easy-to-use search commands, a low hourly rate, and curriculum support made Dialog our service of choice. Searching is incorporated into all curricular areas. Students use Boolean operators to directly control the process, bringing into play their critical thinking, logic and research skills. They realize that finding, analyzing, managing and presenting information is a skill they must possess to meet the information challenges of the future. The advantage of speed, accuracy and currency allows students to concentrate on other aspects of the research process, namely, the higher levels of Bloom's taxonomy. While we chose Dialog, one should not overlook other retrieval services such as BRS.

GETTING SOMETHING FOR NOTHING (OR ALMOST)

Our school, like any other, has limited resources. So when we read about NASA's free on-line service, Spacelink, we were eager to try it. Located at the George C. Marshall Space Flight Center in Huntsville, Alabama, Spacelink provides a wealth of scientific and educational information for the price of a phone call. The data base is set up to provide "easy access to current and historical information on NASA aeronautic and space research. Also included are suggested classroom activities that incorporate information on NASA projects to teach a number of scientific principals." (ref 2) Although this is not an interactive system, teachers and students may leave questions orcomments for NASA to answer. A sampling of main topics includes Current NASA News, Aeronautics, Space Exploration, NASA Educational Services and Classroom Materials. We have found the classroom materials most valuable. A recent search yielded several lesson plans centered around living in space: food, clothing, health, housing, communication, working, and space station research. The lesson plans are well formulated with suggested activities within easy reach of the classroom teacher.

X-Press, X-Change is a basic cable service available to schools at no extra charge. Software and a receiver box turn your personal computer into a news service at your fingertips. The data coming in over the cable line can be captured and later printed. An invaluable service, X-Press provides complete and unedited updated news directly from wire services such as Associated Press, Agence France Presse, Tass, Xinhau (People's Republic of China) and Notimex (in Spanish), allowing students to sample firsthand the reporting of the news from different perspectives. Also available are sports, weather, lifestyles, entertainment, shopping and stock quotations. Any cable company with 20,000 home subscribers is eligible to obtain head end equipment from X-Press at no cost in order to provide this service to customers. Since most schools have a cable feed provided at no monthly charge to begin with, X-Press becomes a real bargain. This service is also available to home subscribers.

NEWS WITH A TWIST

One of the most exciting services to appear on the telecommunications horizon is the USA TODAY Information Network. Using this system, which is delivered over AppleLink and Macintosh Computers, schools can tap into the same high quality news, information, and graphics that Gannett newspapers have access to. USA TODAY newspapers are delivered daily to participating classes. Students can download stories and graphics of interest or related to courses of study, then edit, and layout the articles, perhaps with sidebars offering a local perspective of the news item, and finally, print their own newspapers with desktop publishing software and a laser printer. The local publication can then be distributed to the student body. " It is a great interdisciplinary approach toward awareness of current events, with Technology Education serving as the hub and other departments keying their classroom activities to USA TODAY's contents. " (ref 3) We are currently awaiting the go-ahead to begin this project.

SCIENCE IN THE INFORMATION AGE

Telecommunications, science and geography combine in a new approach to integrated learning in the form of the National Geographic Kids Network. Students in grades 4 - 6 perform requested experiments locally, then upload their data to scientists who help them analyze the information. The analyses come back within 48 hours in the form of charts and maps. An example is the Acid Rain unit where students measure the acidity and alkalinity of local rainwater and then compare their statistics with values gathered by other students from across the country. Future units will include weather, health, land use and environmental issues. The National Science Foundation, through Technical Education Research Centers (TERC), is the major source of funding. Assuming the role of researcher and participating in" real" scientific endeavors, students recognizes for the first time the true value of science and of the scientific process.

CONCLUSION

The goal of all distance learning and educational telecommunications should be to improve the quality of education of the learners. This is an important issue in light of declining enrollments, lack of certified teachers and declining tax bases. The start up costs of several of the above programs are minimal in comparison to the educational objectives that are met by distance education. At Wheatland-Chili, we have neither the funds, the resources, the personnel, nor the time to provide all the services that our students and staff deserve. Yet through the leveling force of distance learning we can be on equal footing with big districts, wealthy districts, culturally enriched districts. At the same time we are indeed preparing our students for the world they will encounter - where telecourses are commonplace, electronic mail the norm, cooperative writing a must and international communications taken for granted.

1. Institute for the Future, Evaluation of AT&T's Long Distance Learning Learning Network (IFTF, Menlo Park, CA, 1988) p. 5.
2. NASA Spacelink, Nasa Spacelink Background (NASA, Huntsville, AL, 1988).
3. Mulvey, Wm., Satellite Communications - Information Network Project, press release (Gannett, Rochester, NY, 1988), np.

USING TECHNOLOGY TO PROVIDE DISTANCE LEARNING: SHARING FIVE YEARS OF EXPERIENCE

Al P. Mizell*

ABSTRACT

Distance learning makes it possible for professionals to pursue advanced degrees and certification using their personal computer, modem, and phoneline; thus, working in the evenings, they do not have to give up their full-time positions. For the past five years, Nova University has offered graduate degrees through computer-based learning to students across the U.S. and in several other regions of the world. Their approach, experiences, and suggestions are shared in this paper.

INTRODUCTION

Known as "open education" or "distance learning," the use of technology to bring education to learners located some distance from the traditional school campus is becoming a popular delivery system for some programs. Although distance learning institutions usually use the regular mail system, a few schools have begun to use high technology as their major communication vehicle to simplify and speed-up communications between students and with faculty. Electronic mail is but one of the many valuable aspects of the new technology. A wealth of tools exist in the electronic medium and schools can begin to take advantage of these techniques to enrich their instructional programs.

In recent articles, a number of institutions and agencies have been described as "on-line institutions." Among these are the Electronic University Network in San Francisco, California (415/956-7177); Connected Education, Inc. in Bronx, New York (212/548-0435); American Open University of New York Institute of Technology in Central Islip, New York (800/222-NYIT or 516/348-3000); Nova University in Fort Lauderdale, Florida (800/541-6682 or 305/475-7047); and NRI School of Electronics in Washington, D.C. (202/244-1600) (ref 1). A recent Jossey-Bass publication describes the work of such institutions in more detail (i.e. Regents College, Walden University, Nova University, National Technological University, Electronic University Network, plus business and industry-sponsored degree programs) (ref 2).

One of the first institutions in the United States to make extensive use of electronic communications for education was Nova University. Nova was established in 1964 and is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools. In 1983, Nova developed two doctoral programs that were directed toward learners using

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their personal computers, modems, and home telephone lines for communications in the evenings and on weekends. Part of the program involves students meeting together for short, intensive meetings so that the human touch is not lost. As it turned out, these brief, but intensive, meetings helped students and faculty forge close relationships that were continued at future meetings as well as online through the electronic technology.

DEGREES OFFERED

The two initial degree programs offered using computer-based learning (CBL) were the doctor of arts degree in information science (DAIS) and the doctor of education degree in computer education (Ed.D./CED). In the DAIS program, students meet every three months for a weekend meeting at one of five regional cluster sites across the United States (i.e. Los Angeles, St. Louis, Wilmington, Jacksonville, or Ft. Lauderdale). In addition, they meet for an extended weekend on campus in Ft. Lauderdale in the summer. The Ed.D. students meet together twice-a-year at one location in Florida for a week-long institute in the summer and a week-long institute in the winter. In 1985, the master of science degree in computer-based learning was added to the online program.

Between meetings (cluster or institute), students meet and talk with each other online and they interact with their faculty in the same way. Normally, students begin a new class shortly before their "live" meetings. They then have lectures, discussions, and activities as a total class when they meet together. Over the next several months, they must complete their required activities and projects independently as described for them in their extensive study guides. Many activities are completed offline and then uploaded for transmission to the faculty for evaluation and reactions. Questions are asked online as needed.

ELECTRONIC UTILITIES

Recently, the Nova Staff (Don Joslyn and Jacques Levin) created a series of electronic utilities to both simplify and structure student-faculty interactions. Using an electronic question system, students call up an electronic menu and then ask questions, send assignments, or seek information. The system automatically makes an archival copy of the questions or assignments, notes it in a queue, and sends a note to the faculty members so they know they have a question waiting. The system keeps a record of the request until the instructor responds. A file record is then made of the answer for future reference. Faculty can make automatic checks to see if they have any questions or assignments waiting in the queue that they haven't acknowledged. When instructors find several students asking similar questions, they can prepare and save a response in the electronic information question system and add it to the menu so future students can ask and then answer their own questions without directly involving the instructor. Eventually, the use of an expert system interface could make this type of response seem like it is coming from a "live person" but the instructor would only need to become directly involved in new or novel situations.

Instructors also make regular use of another electronic utility developed by the Nova staff; i.e., the electronic classroom (ECR). In the ECR, the instructor schedules a time when all students will meet online. They all sign in to the ecr and they then participate in a live classroom setting - but it is on their home computer screen. When the instructor signs into the classroom, the screen is divided into a 14-line blackboard under the control of the teacher and a 4-line window at the bottom of the screen for student use. Normally, a recording is made (electronically) of the entire session so students can replay the whole session later. Unique uses are constantly being discovered for this utility. For example, in one class, students gave five-minute "oral reports" using the system. Two students even gave a group report! The amazing thing is that two of the students were coming online from Germany, one from Puerto Rico, and others were from around the U.S.!

WORLD-WIDE ACCESS

One of the great advantages to an electronic system is that students can access it from any location where a reasonably clean phone line is available. We have had students online successfully from Germany, Puerto Rico, Canada, Hong Kong, Bermuda, Israel, and Finland. During the 1987-88 year, a university instructor from Haemeenlinna, Finland, became a Fulbright Scholar and selected Nova University for his year of residence. He entered the Ed.D. program and worked intensively during the day as well as in the evenings. He managed to complete over two year's work within one year while in the States and is now completing his final year electronically from Finland. We have learned that telephone service in many countries is not clear enough to permit clean data transmission from the student's home. There are also many countries where the government must approve the particular modem before it can be connected. Emulation problems have caused screen distortions for some students, such as those in Germany.

STUDENT PERSISTENCE

We have learned several lessons about student persistence. Unfortunately, the percentage of students completing these programs is about the same as in more traditional programs. There is some greater holding power due to the intense bonding that occurs within the groups of students and is maintained by regular contact online. Faculty are selected because they want to work with students and help them succeed. Therefore, there is a close collegial relationship between students and faculty that encourages faculty to check on students who fall behind. We have learned that when students take a leave of absence for any reason, it is highly unlikely that they will ever return to finish the program. We attempt to keep them active - even if this means at a reduced pace. Students with a strong desire to finish the program and who slightly accelerate the normal schedule are the most likely to finish. Students with a local colleague in the program are more stable because they have someone to discuss their problems with and to encourage them if they start to fall behind.

RESPONSE TIME AND COSTS

In an electronic medium, students tend to develop an expectation for immediate turn-around time. In fact, they start complaining if more than two days go by and the faculty member hasn't responded. Barry Centini, Nova University, is quoted in a chapter of Higher Education in a Learning Society (ref 3):

> "There is a tremendous difference in learning on line ...We try to get a 24 hour response to student assignments from faculty. Students in a normal doctoral program will wait two weeks to get a paper back, and now they expect a response in two days."

Nova recently moved from the use of adjunct faculty to full-time faculty; this has made it possible to insist on rapid response time so students' expectations are being reinforced. This may be an unrealistic expectation.

A major problem encountered in the use of this medium for delivery of instruction has been the expense. Tuition is $4,500 per year for three years. Still, the Ed.D. program has lost money each year until this year. To make the CED program more efficient, it was combined with the other computer-based programs. This organizational change has made the programs financially successful but they are still more expensive to operate than more traditional programs. The goal now is to transfer what has been learned into all of the programs offered by the Education Center at Nova University so that all graduates are computer literate and can be offered an alternative delivery system that uses the personal computer and modem for electronic communication and activities. The lessons we are learning can be shared and should help others move more rapidly into the information age.

1. L. Arden, Home-Office Computing, 104 (Nov. 1988)
2. J.W. Apps, Higher Education in a Learning Society (Jossey-Bass Publisher, San Francisco, 1988) p 122
3. ibid., p 136

C.A.L.L. COMPUTER ASSISTED LIFELONG LEARNING

William J. Seaton

p.271

ABSTRACT

Lecture halls, blackboards, and libraries are having to make room for modems, conferencing systems and on-line data bases created by an emerging phenomena--the "electronic college". With growth of moderate cost personal computers, telecommunication between faculty and distance learners, and among distance learners, is changing the very nature of distance education.

During the past year, Thomas A. Edison State College began a pilot program using personal computers to provide distance education to students. Using a limited number of sites, distance learning stations were created which allowed students the opportunity to telecommunicate with faculty and other students. The system, known as CALL--Computer Assisted Lifelong Learning, allows students to enroll in courses offered through the college's distance learning program.

INTRODUCTION

> "By the year 2,000, most educational services in business, industry and schools will be delivered electronically.
> Why?
> More and more people seeking education are adults who have full-time jobs, who can't afford to live on a campus for several years, who often can't arrange to attend classes regularly. Educational services will have to be provided at **their** convenience in terms of time, place, and pace. And the electronic media are certainly the most efficient and effective ways of doing that." (Ref. 1)

An electronic revolution has been taking place in American society. The development of the microprocessor, improvements in computer communications, major breakthroughs in the storage of electronic information, and the advent of new systems of distributed processing have placed unprecedented computing potential within the reach of many middle class Americans. The dispersment of computer technology was noted in the Chronicle of Higher Education by Elizabeth R. Baer, "So many people use computers comfortably that they are like pencils or calculators" (Ref. 2).

These trends led Turoff (Ref. 3) to propose the concept of an "Electronic University," in which many academic functions would be accomplished through the computer. Students would be "connected" by microcomputers and through modems to a mainframe computer's packet-switched carrier network and thereby be accessible to other students and faculty. In fact, there are a number of successful examples of isolated courses offered on such systems. At Thomas A. Edison State College, the idea for such a system grew out of discussions with the New Jersey Institute of Technology faculty, the creators of the first widely used electronic mail system--Electronic Information Exchange System of EIES.

One might ask the altogether reasonable question of whether the delivery of education via the computer is either feasible or necessary. This issue can be addressed by asking whether an electronic university has any real pedagogical value or simply represents a passing fad. The early evidence (Ref. 4,5,6) suggests that students master the subject matter and student-faculty communication may be more effective with on-line connectivity than with traditional classroom techniques. If these early findings (which represent data from a fairly computer literate user group) can be duplicated with a more general student group, then telecommunications is likely to become a permanent part of distance learning.

Electronic communications between faculty and students can be especially important for distance learners where the academic flavor is quite different from that of the traditional college. For many distance learning adult students, a face-to-face event is quite often a rare or nonexistant occasion. There are few opportunities where students can meet and talk to their classmates with whom they may share courses over the semester.

Distance learners--while typically older, more mature, and better motivated than their "traditional" counterparts--often express needs which requires attention if distance learning is to succeed. Moore (Ref. 7) has identified five qualities which distance learners look for in a program.

First, there should be an identifiable body of knowledge which can be learned at a distance. Second, distance learners look for "guidance in study". Because of the isolation factor, students want direction concerning their learning plan and their learning progress. Third, the opportunity to use the knowledge they are learning is important. Through projects, exercises and writings, distance learners expect to be able to apply what they are learning. Fourth, a knowledgeable and helpful response is desired. "How well did I do? Was my approach to the project correct?" are questions which demand a guiding response. Fifth, assistance with nonacademic problems--such as study skills--is needed. In general, distance learners want student support services similar to those available to campus students. This is the goal of the Computer Assisted Lifellong Learning (CALL) Network at Edison State College.

THE C.A.L.L. NETWORK

By integrating telecommunications and computer technology into its Guided Study program, Edison State College created the Computer Assisted Lifelong Learning, or CALL Network.

Guided Study is a system of learning specifically designed for the distant learner. It allows students to continue pursuing their education without the confinement of classrooms, or campus schedules. Students are provided with a detailed week-by-week syllabus which guides them through the reading and writing assignments. In addition to the basic texts, each course contains an interactively written study guide, a series of unit texts (readings), and video programs. Self-assessment tests and exercises are incorporated into the materials. The video materials are available on 1/2 inch cassettes for use on VHS machines.

All courses in the Guided Study program involve faculty mentors who assess students' progress using written assignments and proctored examinations. Faculty mentors are also available for consultation concerning course content. They are essential components in the success of the program.

The computer can serve distant learners as a manager of learning--presenting assignments, providing rapid response of results, and administering and scoring diagnostic examinations of knowledge. Its pedagogical advantages are rapid communication, enhanced motivation, and student-to-student interaction.

Users in this case are those students who have access through the use of a computer to the computer conferencing software package residing on Edison's "host" computer. Using the appropriate telecommunications protocol, students dial into the host and access this system regardless of time or distance from the host computer.

Specifically for this project, students have been given access rights to the CONTACT system resident at New Jersey Educational Computing Network (NJECN). Course mentors will design and monitor the conferences in which the students are participating. These conferences will simulate specific topic discussions which normally take place in the classroom. However, through computer conferencing, the time that these discussions begin and end really has no impact whatsoever. In fact, students will be able to join the conference, review all relative topic discussions, and add to the discussions regardless of the time of day. Likewise, faculty mentors will have the flexibility of working with the class or individual students at any convenient time.

Students can complete assignments using the word processing capabilities of their personal computers, send them to the faculty mentor's electronic mailbox for review as well as transmit questions about the course material. The faculty mentor reviews the assignment, answers the student's questions, and sends information along with comments to the student's electronic mailbox. The student reviews these messages and proceeds to the next lesson in the course.

CREATING THE INFRASTRUCTURE

By utilizing the services of the New Jersey Educational Computing Network (NJECN), the College has interconnected NJECN's two large IBM mainframe computers and telecommunications systems with Edison's computer systems. Using NJECN's current telecommunications capability, users will dial into NJECN's Comten communications processor to gain access to the network. (The Comten front-end processors currently support a wide range of communications protocols. In technical terms, these protocols include 3270, asyncronous, bisyncronous, SNA, TTY, and X.25. These protocols are the most commonly used and will insure that the vast majority of personal computers and terminals will be able to successfully access the CALL Network.) The Comten processor verifies the student's access rights and route the student into NJECN's mainframe computer. Students are then presented with a menu of current activities available. The student selects an activity and proceeds through the system.

Activities which require data from the College's in-house data base are completed through a direct line from NJECN's system to the College's system using X.25 communication protocol. Students who request data from the College's computer send the request through NJECN's computer to be received by the College's computer. Once the request is received, the appropriate applications are enacted and the necessary data from the College's computer will be forwarded back to NJECN for the student's review.

The access system will assure that students will not be able to modify any data on the College's computer, since they will at no time have direct access to the College's computer. Security on NJECN's computer is completed through appropriate log on routines which allow access only to Edison's program. Users will not have access to any other services of NJECN's computer system and procedures are developed to monitor students' activities and length of logons.

In practice, the program operates as follows: A student with a terminal and a modem, using a nationally available packet-switching network, dials the number and access codes provided by Edison which connects to and is "validated" by the Comten processor. Depending on the information the student requests, the Comten processor either admits the student to appropriate software operating on the NJECN IBM computer or contacts the Edison computer (via X.25) for specific information from the student's record which is then relayed to the student through the Comten processor. The Comten processor, then, acts as a switch between the student and NJECN or Edison, while the packet-switching network and X.25 are vehicles which carry information to and from the student. In summary, this component will allow students to access the CALL Network from any location.

STUDENT SERVICES

Distance learners are provided many of the academic support services traditionally found on a campus. The CALL Network will provide the following services:

Orientation Program: will provide students with general overview of the college and its programs.
Interactive Registration: students will be able to register with the college and take courses.
Interactive Payment of Fees: using VISA or Master Card, the payment of any college fee can be accomplished.
Examination Program Inquiries: a description of all standardized examinations (CLEP, ACT-PEP, etc.) will be available.
Examination Study Guides: a request for examination study guides can be made and the study guides delivered to the student.
Diagnostic Examinations: students will access a computer diagnostic examination program which will allow them to pretest their level of knowledge in any number of areas with diagnostic remediation provided as needed.
Correspondence Course Inquiries: student will be able to search a data base of nationally available correspondence course programs.
On-Line Advisement: student will be able to contact an academic advisor to have questions answered and to obtain advise concerning their academic program.

Most critical will be the on-line advisement services. Degree advisors can access a student's academic record on-line and instantaneously provide the necessary advice to the student regarding course requirements, prerequisites, experiential learning, examination opportunities, etc.

CONCLUSION

Several years ago, it became abundantly clear that adult learning in America was changing rapidly and that this change was going to have a significant impact on higher education.

The most visible change was the decline in the percentage of traditional aged students in the classroom as increasing numbers of older and part-time students took their seats. Today, more than one-third of all students enrolled in credit courses are over the age of 25. Most of these students are part-timers, and many not only hold jobs but are raising their own families (Ref. 8). These students are looking for an alternative to the traditional approach to learning, not as an easier way to a degree but because their life circumstances demand it.

While the number of adult learners is placed at over 60,000,000, only about one-third of these are learning through colleges and universities. Tens-of-thousands are pursuing their education through the work place and business sponsored seminars and training activities. These learning activities are crucial for the occupational survival of the participants, but often do not engage the student in the classical elements of a liberal arts education.

The program outlined above is an attempt to address this issue. It seeks to provide non-traditional learners with the fundamentals of a sound liberal arts education, using the new electronic technologies to deliver that education. If this project is successful, it will demonstrate that philosophy and modems need not occupy separate worlds--one cloistered in ivy and the other in silicon--but that together they can provide learners with the vision and tools needed for the future.

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THE VIRTUAL CLASSROOM PROJECT: EXPLORATIONS IN DISTANCE LEARNING

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ABSTRACT

Discussion of the design, implementation and results of a distance learning facility. The problems encountered are examined. The final results were positive and encouraging.

INTRODUCTION

The Virtual Classroom (VC) was started in 1985 and was designed to be an alternate method of classroom presentation and course deliveries.

While most educators feel that the normal face-to-face mode of delivery is best, it is often difficult or even impossible for many students to attend. Other mediums were developed, including Mail and Video courses, but for the most part, these were passive. The students had little, if any, interaction with the instructor or the other students.

The VC can combat these problems by allowing a level of communications and interactivity not available in these other modes. The VC can operate independently, or in cooperation with other mediums. Its goals are to increase both access to, and the quality of, higher education.

Within the VC, each student and the instructor access a centralized computer system that is running a computerized conferencing system. This allows the student to send electronic messages to the instructor, as well as other students. The class is provided with a "conference" to allow for group meetings and discussions. A conference differs from mail in the respect that the items entered into the conference are available to the instructor as well as the rest of the students. Another major advantage to this mode of delivery is the 24 hour access to the system.

MODES OF DELIVERY

We have identified three modes of use for the Virtual Classroom.

The first of these is Totally Online. In this mode, all lectures and assignments are presented over the conferencing system. The students turn in all assignments via the system.

The second is Mixed Mode. In this mode, the presentation of the lectures and assignments uses the VC in cooperation with another medium. For example, this mode could be used with a video course. The bulk of the lecture is presented over another medium, then the students access the VC for additional notes, assignments and access to the instructor.

The final mode is the Virtual Lab. This can augment a class that requires a great deal of student interaction. In a Management course offered at NJIT, for example, several groups of students were required to form "companies" that competed against each other. The major problem with this course is getting the students together outside the classroom.

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With today's commuting environment, this is a monumental task. In the VC, this becomes almost trivial and leads to more communication amoung the students. In fact, the teacher was often amazed at the results in this mode of delivery. He was able to take these students much further with the VC than with his traditional face-to-face section.

Two of the initial target audiences were the physically handicapped and the geographically dispersed. During development, other audiences were discovered. Due to the constant reassignment and relocation of it's personnel, the military has expressed intrest in the Virtual Classroom.

COURSE PREPARATION

From experience, the first time a course is offered online, it will take approximately 100 to 300 hours of preparation. This varies with the type of course being offered. After the initial offering this drops greatly.

When preparing the first of the lectures the instructor should be aware that, for many of the students, this will be the first time they have been exposed to this form of presentation. In view of this, the first lecture should have very little to do with the actual class itself. It should be an opportunity for the students to access the system, learn their way around, and become comfortable with the mode of presentation. Typical assignments for the first week consist of sending a message to the instructor, entering a comment in the class conference, taking a sample quiz, and running a sample program.

For the second week, only 50 to 75 percent of the normal class lecture should be entered online. This will allow the students to ease into the system. While this appears to waste a great amount of class time, we have found that students taking online courses can handle more material than students in the traditional face-to-face class.

SOFTWARE FOR THE VIRTUAL CLASSROOM

The first problem we encountered was a way for the students to take exams online. We implemented a simple quiz facility. The instructor could prepare a true/false, multiple choice or essay question. We also developed an automatic correction feature. The quiz had a built-in timer that placed a limitation on when and how often the students could take the quiz. A more robust exam facility is currently in the design stages.

Another of the tools that we developed was an electronic gradebook. The instructor maintains their student's grades on the system. This allows the quiz and exam facilities to automatically access and updaye the gradebook. The student can also access the gradebook. When they request access, their grades are displayed as well as the class averages for each assignment and the overall class average.

CLASS PARTICIPATION

It has been determined that a typical VC student should log on to the system at least three time a week, to read the lectures, do the assignments, and to keep abreast of the class discussions.

The major percentage of participation in the classes consist mainly of reading the lecture and doing the assignments. Nevertheless, this unique mode of delivery presented new variations to some old techniques.

The first concerns individual responses. In the normal face-to-face class, the tone of the answers is set after the first few students respond. The other students are often hesitant in presenting a view that might be different from the ones already expressed. In the VC, the teacher can establish a group question, in which a student must first provide their own answer before being allowed to see the other student's responses. This insures that each student first presents his or hers own view before being influenced by the answers of the other students.

Another advantage is anonymity. Each conference comment and message has three optional forms of signature: Full name, Pen name, or Anonymous. A Pen name is a name that the student selects and doesn't reveal. The student may now ask questions of the instructor, without the instructor knowing who is asking the question. This helps to overcome a student's fear that they will ask a "dumb" question. The teacher can respond to a message by addressing the response to the Pen name.

A further refinement is complete anonymity, in which the instructor can not respond to the author of the message. This is useful for the students to provide the instructor with suggestions without fear of biasing the instructor against them. This method can also lead to abuse but, if wisely used, can lead to a more productive working relationship.

Aside from the activities presented before about group communications, the VC also lends itself very nicely to group programming. I designed a program for my students, broke it down and gave each of them a piece to develop and test. They then sent me their section of code and I combined the modules and ran them as a whole. This gave them a greater understanding of teamwork and a more realistic look at being part of a programming team.

PROBLEMS AND SOLUTIONS

During the initial testing of the VC, we selected students from NJIT and Upsala. Due to the nature of the test groups, we found students taking quizzes together, passing around answers, and handing in other people's assignments. While this goes on in many classes, the naturally unsupervised atmosphere of the VC can accentuate the problem.

Through our investigations of more geographically dispersed students, we discovered cheating to be almost non-existent. This is due mainly to the fact that the students are not familiar enough with each other to take the risk of asking them to collaborate in a cheating venture.

We had problems with the students not understanding that the comments in the class conference would be read by others. This led to some students using inappropriate language. This was solved by placing more emphasis on the regular classroom environment. Students were told that the class conference is just like a classroom and if a comment is inappropriate in the "real" classroom, it is inappropriate in the "virtual" classroom.

We also had our share of deliberate problems. Some students had a tendency to allow their friends to use their accounts. Another student discovered an instructor's password and logged into the account. In these cases, it became very clear that the students responsible were not well suited for the Virtual Classroom. In most cases, they were allowed to transfer to a regular section of the course.

THE RESULTS

The results were very encouraging. A majority of the students were very pleased with this mode of delivery, felt it was more convenient than a traditional class, and would like to take another course in this fashion. The instructors were also very happy with the outcome and are planning to use the Virtual Classroom in the future.

There were, of course, some negative reations to the project as well. Some students suffered from information overload and dropped out in the beginning. Some complained that they did not have the self-discipline to participate in this mode and let other activities distract them.

As for the effects on learning in this mode, as measured by objective midterm and final exams which were all given in the proctored face-to-face mode, Dr. Hiltz reports that overall, when comparing face-to-face with the Virtual Classroom, there are few significant statistical differences. Many of the instructors agreed that, in most cases, the quality and quantity of work produced by the VC students was superior, particularly group work.

THE FUTURE OF THE VIRTUAL CLASSROOM

A proposal has been initiated to apply for funding to continue the VC development in a nationwide participation project including four universities: NJIT, Upsala, George Washington University, and Arizona State University. These institutions will be presenting and developing new courses to be taught in the VC environment. Courses include Computer Science, French, Anthropology, Management, and Liberal Arts.

Connected Education is a not-for-profit corporation that uses the Virtual Classroom environment to offer courses entirely online for graduate and undergraduate credit granted by The New School for Social Research and by Polytechnic University. In the past three years, they have offered over 60 courses to more than 350 students in 22 states and 10 nations.

ACKNOWLEDGMENTS

Major funding for the Virtual Classroom was provided by NJIT and the Annenberg/CPB Foundation. The Author wishes to thank Andrew Hoey, Allison Bramham, and Paula French for their help in preparing this paper.

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COGNITIVE SCIENCE: A BASIS FOR DISCUSSING ARTIFICIAL INTELLIGENCE IN EDUCATION

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ABSTRACT

The paper deals with the problem of acquisition and representation of knowledge in the light of cognitive science, as a basis for discussing applications of artificial intelligence in education. Cognitive science is defined as an interdisciplinary field of study involving concepts, ideas and principles from the areas of philosophy, psychology, linguistics and computer science. Models of knowledge from these areas and particularly from schema theory are presented. All discussion is developped in order to faciliatte comprehension of how cognitive science may contribute to the design of each one of the structures of an instructional expert system. This system is defined, according to the literature in artificial intelligence area, as a knowledge based system which applies knowledge in an active way, reaching performance expertise and using tutorial and student models.

INTRODUCTION

Applications of artificial intelligence in Brasilian educational environment have been discussed through the design and implementation of instructional expert systems (IES) in the light of cognitive science.

The objective of this short paper is to explain how knowledge occurs, according to cognitive science, and to point out how to relate contents of that field of study with the generation of IES structures.

COGNITIVE SCIENCE

Cognitive science is an interdisciplinary field of study that studies cognition or the representation of knowledge, receiving contributions of psychology, psycholinguistics and computer science. These contributions are related to philosophical perspectives about knowledge and may help understand schema theory which is one of the cores of cogitive science.

Contribution from other Fields of Study - From a philosophical point of view (ref.1), there are at least three perspectives that explain the process of acquisition and representation of knowledge. They vary according to the emphasis given to the object (environment where the action occurs), to the subject (source of an action) or to the interaction between object and subject in the process. According to this last perspective, knowledge acquisition is considered to be determined by a combined effect of both the subject and object through an operative process. Here the focus is on the relation between subject and object which act together in a continuing process of knowing.

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In the area of psychology (ref 2,3), each of the three perspectives can be found, although the last is the one that explains knowledge in a more comprehensive form. It provides a constructive learning paradigm, parallel to the behavioristic and rationalistic ones which had dominated the theory of learning for many years.

According to the constructive approach to learning, knowledge is not static nor is it a product of the learner's existing structures. Knowledge is acquired, transformed, used and stored by means of the learner's constructive mental processes in interaction with the object of learning. In other words, knowledge is actively constructed by the human organism, through interrelations between the external representation of what is presented to the learner and the learner's own mental processes. This constructive view of knowledge is defended by at least two theories: the genetic epistemology of Piaget (ref 4), and the learning and instructional theory of Gagné (ref 5).

Genetic epistemology describes different cognitive structures corresponding to different stages of development. The learning adn instructional theory of Gagné emphasizes internal and external conditions of learning. These conditions are explained in the light of an information processing model of memory and learning, which is employed by modern theories in the area.

Besides the above ideas on knowledge, researchers, like Meyer, (ref 6), concerned with the question of representation of knowledge, and based on linguistic studies, develop a way of diagramming sentences and paragraphs to make explicit the relationships within a passage and to represent its discourse structure.

Also, a group of cognitive scientists, using concepts and principles from psycholinguistics and computer science (ref 7,8,9), develop the notion of schemata.

Schema Theory - In the last decades cognitive scientists have discussed the problem of the representation of knowledge in a context of studies on the perception, conceptualization, encoding, storage, and retrieval of information, viewed as acts of construction by which individuals construct mental representation of the world.

Discussions on the characteristics of information stored by an individual influenced the creation of many models, such as the semantic network and the semantic features presented by Klatzsky (ref 10). The semantic network model emphasizes hierarchical interconnections among concepts, pointing out the semantic distance between them. The semantic feature model emphasizes the aspects which qualify the concepts. Both models discuss propositions stored in human memory. However, the cognitivists search for units of high order that involve propositions and are actually representative of human knowledge. Despite the differences between particular theories (ref 9, 11) in explaining the human knowledge, it is reasonable to group all these theories into a comprehensive theoretical labeled schema theory (ref

1).

Schemata are highly organized memory units representing abstract prototypes of concepts, actions, or events. Schemata are characterized by variables, constraints on the values of the variables and expectations about new incoming information. Schemata facilitate drawing inferences, direct the interpretation and understanding of information and guide performance. Schemata serve different purposes and are related to proposition knowledge, use of rules, attitudes, and creativity. Some outhors, like Minsky(ref 12), refer to schemata as frames. This expression is largely used by studies (ref 13) in the area of artificial intelligence. Other researchers (ref 7,11, 14) use the terms plans and scripts to refer to more or less abstract schemata.

In relation to comprehension and the knowledge process itself, the schema theory defends the following ideas. The comprehension of a situation occurs when information from the situation fills the schema slots corresponding to the schema variables, by means of instantiation. This means that the information provides instances for the slots in a learner's schema, and is encoded or assimilated. In this way, comprehension is dependent upon the fitness of the information to the learner's schema expectations. If these expectations do not fit the information, the information is not encoded and is distorted in order to be consistent with the expectations. The expectations also permit one's drawing of inferences that are related to gaps in the available information. Also, the expectations guide information retrieval and reconstruction.

COGNITIVE SCIENCE AND INSTRUCTIONAL EXPERT SYSTEM

Expert systems are knowledge based systems which apply knowledge in an active way, reaching performance expertise (ref 15). They represent the concept of computer as an information processing system, which is devided into a series of storage structures and stages of input processing, closely related to human information processing. The system has the following basic structures: a knowledge base, an inference engine and an interface for facilitating communication between computer and user. Studies have shown the possibility of developing instructional expert systems (IES) which are expert systems using tutorial and student models (ref 16).

Cognitive science, as discussed here, brings a great contribution to studies on expert systems and to their utilization in educational environments.

First of all, theories of learning and instruction based on information processing model of memory, such as Gagne's, help to discuss information processing in machine. Also, the constructive view of knowledge contributes to the design of IES with increasing ability to make the machine present solutions to problems that would be considered intelligent, if achieved by human activity. An IES needs a student model that allows computer to control what learner does, what he does not understand, and how he achieves solutions to problems. This model gains feasibility when it is constructed by using concepts of genetic epistemology, particularly those which permit to characterize different models of learner's knowledge,based on different levels of cognitive structures. And the tutorial model of an IES may be discussed using Gagné's theory. The model would controll all system, managing instructional events, accordins to learner's internal conditions.

In addition to that, the basic structures of an instructional expert system may be studied in the light of concepts and models from psycholinguistics and schema theory. Knowledge base of an IES implies a model of representation of knowledge in machine, and has been constructed by using techniques such as: semantic networks; frames; and systems of production, which means a set of rules, establishing the conditions of occurrence of an action (ref 15). These techniques are closely related to discussion of cognitive scientists on the characteristics of information stored by human memory.

Last but no least, the notion of schema as well as the explanation of comprehension, as given by schema theory, help to construct an inference engine more similar to human reasoning. This inference ingine has the functions of making inferences and controlling search for an answer, using knowledge base and input information from user.

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STEREOTYPES AS A BASIS FOR STUDENT MODELS IN COMPUTER BASED TUTORING SYSTEMS

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ABSTRACT

Computer based tutoring systems have existed for many years now but as a group they are unable to respond to the needs or expectations of the individual student. This inability is one of the reasons such systems are considered to be unintelligent. An intelligent tutoring system must, among other things, be able to model the student user. This paper argues that human tutors take advantage of the information provided by stereotypes to develop a model of the student and that any intelligent tutoring system must do the same.

INTRODUCTION

When a tutor meets a student for the first time the tutor must make a number of decisions, including, which material to present and how to present it. On what basis are these decisions made? This is one of the problems developers of computer based intelligent tutoring systems face. Such systems need to create a student model based on relatively little information about the student user. This paper argues that human tutors make their decisions based to some extent on the use of stereotypes and that computer tutors should do likewise.

Whenever two humans interact for the first time, they seem to function using stereotypes. Each individual quickly sums up the other using more or less obvious characteristics such as age, race, nationality, style of dress, and posture. As the two individuals come to know more about each other, they modify their stereotype based models of each other to fit the new information they have received. When used in a 'healthy' manner, the assumptions derived from stereotypes function only until knowledge about the specific individual is available or until the assumptions of a more appropriate stereotype are substituted.

This model of human interaction applies as well to the tutoring situation. When a human tutor first meets a student, a set of student oriented stereotypes is triggerred. These act as starting points for the tutoring interaction, supplying the basis for a student model which, in turn, is used to determine what to look for or test for in the student, what ways to initially approach the subject matter being tutored, and what misconceptions to expect. As the tutor comes to know the student, the stereotype based student model goes through the same modification process described above. In this way the student model gradually evolves to being based more on the student's actual behavior.

If human tutors rely on such stereotype based models, it would seem logical that the use of appropriate stereotypes would be a useful, if not essential, part of any intelligent computer tutor. This paper discusses that notion after first presenting a brief description of another application of stereotypes in a computer program.

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GRUNDY AND THE USE OF STEREOTYPES

Elaine Rich in her 1979 Ph.D thesis [Ref 3] presented a well developed application of stereotypes in a computer program. For her demonstration system, Rich chose the task of a librarian trying to recommend a novel to a library patron. The real task in such situations is to make a recommendation based on a minimal amount of information. A model of the patron is developed from the responses to a few questions along with such data as the sex, race, approximate age, and physical fitness of the patron. Rich assumed that the librarian used stereotypes to turn this small amount of data into a user model.

To test this idea and to test the applicability of stereotypes in a computer based system Rich developed a program called Grundy to model the behavior of librarians. To start a recommendation session with a new user, Grundy asks a set of preliminary questions. Based on the answers to these, Grundy activates one or more stereotypes. In the program a stereotype is a set of attribute, value, rating triples. An example of an attribute would be education and its value would be a number or other indicator to designate how educated a user is. The rating represents the confidence one has that the value given to the attribute is correct for this stereotype.

Something has to trigger the activation of stereotypes. In Grundy a trigger is an object associated with a particular situation. Situations include words typed by the user, responses to questions, values given to an attribute and even other stereotypes being activated. For each situation there is a list of trigger objects containing the trigger name, the name of the stereotype to be activated, and a rating indicating the confidence the system has that this stereotype is appropriate given this trigger.

The whole point of stereotypes is, of course, to help create a user model. For Rich such a model consists of information gleaned from the user, inferences from the users actions, (for example, acceptance or rejection of a recommendation), and the predictions made by the stereotypes. The model itself consists of attribute, value, rating triples with the values being filled in as information becomes available from any of the above sources.

APPLYING RICH'S IDEAS

It was argued above that human tutors use stereotypes, so it seems natural to attempt to create stereotypes for an intelligent computer based tutor to use. Human tutors get their stereotypes from life, from any formal training they receive, and from the experience of tutoring itself. Computers will need to have their stereotypes provided by programmers but first it must be determined just what the appropriate stereotypes are. That is a major focus of the research to date and it is part of a larger effort to define which attributes are necessary for a student model as well as how best to determine their values.

An example will help explain what is being done. Suppose I want to build a tutor to help students learn to program in Pascal. First hand experience and observations of others in tutoring situations have led to the conclusion that a tutor needs to know: the student's ability to analyze, his or her Mathematics ability and interest level, how much Pascal is understood already, major and minor (if declared), English proficiency, and perferred style(s) of learning. All these represent useful attributes for the student model. Few people would argue with the usefulness of these. The question is: just how useful is each attribute? Put another way, what will each of these tell us about the student and how reliable is that information?

Take mathematics ability as an example. Such ability is relevant if one is considering using mathematical examples or problems. It may also be important if one is trying to determine a student's ability to abstract or develop a model of a problem situation based on an English description. However, if the latter is the goal, perhaps the focus should be on the student's proficiency with mathematical word problems or with English itself.

To develop a useful stereotype it is necessary to know what that stereotype will indicate about the student. In other words, a stereotype of someone who is proficient in Mathematics is only useful in creating a student model if that stereotype predicts the values for attributes in the student model. Certainly a mathematics proficiency stereotype will reliably indicate that mathematics examples are valid but, as noted above, it is not so clear how well, for example, it will predict one's ability to make models of a problem situation.

There is also the related issue of determining appropriate triggers for the stereotypes. Stereotype triggers can have as their source any form of computer-student interaction available to the computer. This includes the use of certain keys such as the HELP key or keys involved in the manipulation of simulations, answers to computer generated questions, as well as data from a database.

Focusing again on the student's math proficiency: how does one determine that proficiency? Note that it is likely that two questions are being asked here: how do we determine the value of an attribute (or set of attributes) related to math proficiency and what are the triggers for a math proficiency stereotype. One could have the computer give a mathematics test as part of the tutoring introduction but few students would accept that. Other sources of information that involve one question to the student or using information provided by a computerized database include math grades, math courses taken, and the student's major or minor.

The student's major is a good example of a trigger that has been observed to be used by human tutors. When a student with a major in the physical sciences comes to a human Pascal tutor, it is much more likely that the tutor will use examples involving mathematics. Only if the student has trouble with the mathematics, will the tutor modify his or her stereotype and therefore the examples used.

Attribute values (triggers) such as a student's major represent one important use of stereotypes in developing a student model. A second potentially important use is in misconception diagnosis. Traditionally, the problem with such diagnoses is that the search space is potentially too large: there are too many misconceptions to choose from and the evidence for determining a misconception is too varied. This situation is made more manageable, however, if misconceptions are treated as stereotypes or as attributes of stereotypes.

As stereotypes, misconceptions describe how an 'average' student with a specific misconception thinks about a particular topic or concept. What often complicates misconception diagnosis is that a student does not necessarily exhibit all the characteristics of the misconception. Some models try to avoid this problem by creating a large number of simple misconceptions or bugs (simple in the sense of having few characteristics) [Ref 1] but this only increases the size of the search space. Similarly, it can be difficult to model a student who is 'unlearning' a misconception. Usually some aspects of a misconception will linger longer than others.

If misconceptions are stereotypes then the misconceptions themselves are not part of the student model. Rather, they are potential sources of information regarding those portions of the model dealing with particular concepts. As an overly simple example, suppose we have a concept with 3 features, call them x, y, and z. The student model needs to represent the student's understanding of each of these. There may well be numerous sources of information to help determine the student's understanding, some of them perhaps being misconceptions. If, for example, the student has misconception A, then she or he thinks such and such about x, y, and z.

If such a misconception is diagnosed as being part of the student's understanding and is incorporated directly into the student model, then the student is represented as thinking about x, y, and z exactly as the misconception says. If, however, the misconception is only a stereotype, it becomes only one source of evidence. Other evidence can also be used to determine the student's understanding of x, y, and z. If, for example, there is strong evidence that the student grasps x but there is no such evidence for y and z, the student model can reflect both the student's correct understanding of x and the suspected misunderstanding of y and z.

CONCLUSIONS

Stereotypes seem to be a useful tool in the development of user or student models. They are not a total solution to the problem but they do seem to make more tractable some of the issues involved in creating a useful student model. Research is presently in progress to determine which stereotypes are most useful in student model building and on how to actually integrate stereotypes into a computer program that will act as an intelligent tutor. Once such a computer program is built it will be used to test the hypothesis presented here.

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PEAKSOLUTIONS' CURRICULUM INFORMATION KNOWLEDGE BASE: THE VISION AND ITS IMPLICATIONS

Kit Ketchum*

ABSTRACT

A Knowledge Base of course content goals has been developed with software using expert systems technology. By planning courses with PEAKS Course-Building Software, instructors at the Minnesota Technical Institute System have introduced more flexibility into course delivery, and more consistency into course documentation. This flexibility has prepared Institutes to accept part-time adult students, a major revenue source. Lesson planning and class scheduling software access the same Knowledge Base, strengthening consistency between course planning, delivery, and scheduling. Future plans for expert systems to advise counselors (sales representatives) about planning customized courses for businesses are discussed.

INTRODUCTION

Minnesota's Technical Institute System consists of 34 campuses, where 3000 instructors teach over 30,000 courses.

In 1988, this organization faced a major dilemma: Declining enrollment in their traditional, full-day programs. They needed to restructure their programs for more adult students, who need career training or skill improvement on a part-time basis. Furthermore, they wanted to make their programs flexible enough that they could sell training directly to businesses, tailoring the training to the needs of particular groups of employees.

The Technical Institute System needed a way to clearly describe and document course content. They wanted their instructors to create concise, consistent content goals, with clear, student-oriented performance objectives. Once that had been done, they needed tools for accessing that course information in many different ways, to plan instruction, create exams, schedule classes, meet administrative needs, and create a sales catalog (1).

HISTORY

Dr. Rich Pointer, Assistant Director of the Technical Institute System, was struggling with the problem of training 3000 instructors quickly in a formal method of course planning and documentation. Most of the instructors were skilled in their professions, but had little or no formal pedagogical training. Initially, Dr. Daniel Vogler, of Virginia Polytechnic Institute, was employed as a consultant, teaching the instructors a method of course planning which he developed. Dr. Vogler taught classes of 30 instructors at a time how to use his method (3), through pencil and paper techniques. The results were mixed, both in speed of training, and in actual implementation of the material by the instructors.

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Through consultation with PEAKSolutions Corporation, Dr. Pointer learned that an expert system could be developed to capture Dr. Vogler's expertise and deliver it to the instructors at all the Technical Institutes, allowing them to develop course curricula more quickly and effectively than before. Furthermore, the output of this system would be the beginning of a statewide curriculum information knowledge base encompassing a large collection of coded curriculum content goals. This knowledge base would encourage consistency among programs offered at different campuses, and allow the Technical Institutes to selectively join together pieces of different courses for delivery to businesses.

THE BEGINNING: BUILDING COURSES

The software tools for working with the Curriculum Information Knowledge Base are known as the Curriculum Information Suite. The first section of the Curriculum Information Suite is PEAKS CourseBuilding Software. This PC-based software package leads instructors through identifying content goals for their courses. A format is presented for defining content goals, such that each content goal is specified as an observable action. The instructor identifies the domain, frequency, difficulty, and purpose of the content goal. Then the instructor is prompted through a series of templates to help define the performance standards and the testing conditions for each content goal. The resulting performance objective defines the action to be performed, the standards of quantity, quality, efficiency and durability to which it will be performed, and the conditions under which performance will be tested. These content goals and performance objectives are summarized in a structured course syllabus, which the instructor creates on-line, including point assignment and letter grading. The resulting syllabus represents a comprehensive course document for distribution to students, advisors, employers, and accreditation agencies.

DELIVERY OF CONTENT

The content goals created by the instructors using PEAKS CourseBuilding Software are the input to PEAKS LessonBuilding Software. This package embodies Dr. Vogler's method (4) to help instructors create lesson plans or self-paced modules for each content goal in a course. The software helps the instructor determine which theories of learning are most appropriate to the content goal being taught, and which instructor practices are most appropriate to the theory of learning selected. The instructor identifies what actions he or she will take in the classroom, what additional activities the student will complete, and what out-of-class assignments the student will do. The instructor also specifies requirements for pre-testing, post-testing, and exemption-testing, if any. The resulting package is a lesson plan specifying how an instructor will address a particular content goal. The lesson plan can be shared when content is taught in more than one course, and is a significant help to a substitute or new instructor. If the course is to be taught in a self-paced format, PEAKS LessonBuilding Software produces a Learning Module document, specifying to the student all of what must be done in the module.

ADMINISTRATION: SCHEDULING

Another tool in the the Curriculum Information Suite helps schedule classes. PEAKS ScheduleBuilder uses a method developed for the Minnesota Technical Institute System by Dr. Paul W. Prins (2), for a department head to plan programs for various groups of students, and then schedule those groups, with faculty, into rooms. The program leads the user through an approved process for scheduling based on lecture and lab credit hours, and accumulates department schedules, which are examined for conflicts when all the departments have been scheduled. The program points out conflicts to the institute director, and offers suggestions for resolving the conflicts.

Employees of the Minnesota Technical Institute System are already working on connecting the student group schedules to registration and tuition databases, with the result that soon a counselor will be able to discuss courses with a student, register the student, and issue a tuition invoice all in one visit.

Since so many of the Technical Institute System's students are covered by various financial aid programs, another program being considered for development is an expert system for Financial Aid to interface with the registration system. This system will advise the student which financial aid programs apply to their particular situation, and possibly even fill out the application forms for the student. Anything that makes it easier to pay for a product is a benefit to the seller!

SELLING INSTRUCTIONAL CONTENT: THE TRAINING ADVISOR

Another agenda of the Minnesota Technical Institute System is to provide more of their instruction directly to businesses, custom tailoring courses to exactly meet the needs of groups of employees. Businesses recognize the need for training their employees, but frequently find that generic programs waste time and money by requiring topics which are not directly related to the immediate job. Bill Weiser, the Assistant Director in charge of the Custom Training program, faced the task of assembling and training a group of training counselors who would function as sales representatives, to meet with businesses, ascertain their training needs, and recommend which parts of the 30,000 courses offered in the Technical Institute System best met those needs. For a person to memorize, or even attempt to become familiar with that many products, is a mammoth undertaking.

To meet the needs of these Custom Training sales representatives, a Training Advisor Expert System which accesses the Curriculum Information Knowledge Base will be begun in 1989. This program will lead the sales representative through an intelligent questioning strategy to discover the training needs of a prospect business, and then recommend which existing courses or groups of content best meet that need. Training offerings will be assembled from the content of many different courses, possibly from different campuses, with different instructors teaching the appropriate segments This will lead to a savings for the Technical Institute System in reduced training time for sales representatives, a savings in reduced duplication of course material, and an increase in revenue due to meeting customers' needs which could not previously be addressed. The benefit to businesses will be that training will be better targeted to their needs. Employees will benefit by having fewer of the frustrating "false-starts" that make people give up on training. The data gathered by the sales representatives will be available for market research, leading to identification of "holes" in the available material, which represent opportunities for new development and sales.

OTHER POSSIBILITIES

In planning the future, once the Curriculum Information Knowledge Base is in place, the Minnesota Technical Institute System will be able to create expert systems for student needs assessment and placement, for career guidance, for employer needs assessment, for access by accreditation agencies, and many more.

SUMMARY

Through tools in the Curriculum Information Suite, the Minnesota Technical Institute System is documenting the planning and delivery of all courses taught in the system, encouraging consistency between campuses. While previously, Auto Mechanics was a 14-month course at one campus, and a 22-month course at another, and nobody really knew what was different; now the programs are broken into 3- and 4-credit courses, offered over a 12-week span, with 80% of the same content. The flexibility and consistency are possible because of the Curriculum Information Knowledge Base.

Administrators who had never scheduled groups of students before are finding the task much easier than they had thought, due to PEAKS Schedule-Builder, which ensures that all parts of a course are scheduled properly.

The Training Advisor system will, when complete, make the training resources in the Technical Institutes more accessible to Minnesota businesses and training organizations, allowing the Technical Institute System to fulfill their mandate to serve business better, while generating more revenue for the Institutes.

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AUTOMATION OF THE TEACHING OF INTERVIEW SKILLS.

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ABSTRACT

This paper continues the description of research presented at the last conference, and outlines further progress. The research underway aims to develop an expert system for use as a computer assisted learning package. This system will be used as a supportive tool in the teaching of selection interviewing skills.

It is acknowledged that knowledge acquisition occupies a central role in expert system development. As it is proposed to emulate an expert selection interviewer, obtaining knowledge about how to interview is of paramount importance. This paper outlines the present state of this research with emphasis on the techniques being employed,particularly the use of automated knowledge elicitation methods. Finally,the development of a formal model of the expert interviewers and trainers in this field is described.

The selection interview is a well established assessment tool, often used alongside other techniques,but frequently alone. Most published research has concentrated on the reliability and validity of the selection interview, with extremely pessimistic conclusions,as reported in Mayfield's 1964 review of pertinent research [ref 1]. However, as the use of the selection interview remains almost universal, it would seem that concentrating on low predictive ability of a technique in such widespread use is counterproductive. Interviewing skills are evidently important to every company that uses them, and it would appear from the criticisms that such skills are subtle, and difficult to pass on. It is proposed that what is required is a more rigorous knowledge of the processes taking place in the interview. This research is concerned with eliciting such knowledge from established interviewing experts and incorporating this into a formal model of the process. This will then be used to establish a knowledge based computer model for subsequent incorporation into a knowledge transfer system. The final system will facilitate the teaching of novice interviewers by allowing them to

a] explore and define the objectives and operation of their interviewing in detail, without the intervention of an expert [particularly useful for in-service development]

b] simulate the interview process. As a learning experience, simulation can prove invaluable, particularly in the area of interpersonal skills.

This project is currently at the stage of knowledge elicitation. The expert interviewers taking part come from various industries, and are defined as those people who have been engaged for some time, at least as part of their job, in selection interviewing. In most cases they have been recommended by colleagues in the same firm.

Various elicitation methods have been used. As it was not entirely clear at the outset how structured or clear the

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knowledge in this domain would be, it was felt that to rely solely on one approach would be disadvantageous.

The first method employed was the fact-finding interview. This is a well established form of data collection used in systems analysis, which has transferred well to expert system development. The form of interview which proved to be of most value was the "critical incident technique". The expert recalled incidents related to the job which have stuck in his/her mind. By being asked to describe feelings at that time, the expert is more likely to recall actual behaviour. Difficult, or interesting cases are more memorable and stimulating for the expert, and useful information could be extracted more quickly and fully than with more mundane cases. However, care was taken to ensure accuracy, as interesting cases are not always typical or recalled with total accuracy. It was also noted that it is human nature to show oneself in the best possible light, and that expert interviewers are, by definition adept at manipulating interviews. For this reason the information was gathered via face to face interviews and postal questionnaires, the latter yielding 75% response. It was felt that what an interviewer might not say when being recorded, s/he might write in response to a confidential questionnaire and vice versa.

The information gathered in this manner was used to establish possible processes and to examine how those processes manifest themselves in more generalised situations. Having established what decisions are made, the experts were asked to reclassify those decisions. Given the goal [decision] the expert can specify what evidence would be used to make and support that goal. Working backwards from the final decision, each intermediate decision can be identified and examined. This minute examination can lead to an extremely structured analysis of the knowledge and expertise. From examination of the data, it appears that several distinct stages of behaviour or attitude are apparent in interviews. Briefly those stages comprise

1. Preparation - given a job description an interviewer builds a specification of interview objectives together with an expectation of an ideal candidate. These are partly implicit.
2. A cognitive framework, or template, is developed into which information gained will be placed for matching. Given the specification in 1, the framework becomes "slots to be filled" [expert's phrase].
3. The candidate is greeted and given information.
4. Information is gathered.
5. The framework is filled in and possibly re-established.
6. The candidate is debriefed.
7. Decisions are made and consolidated.

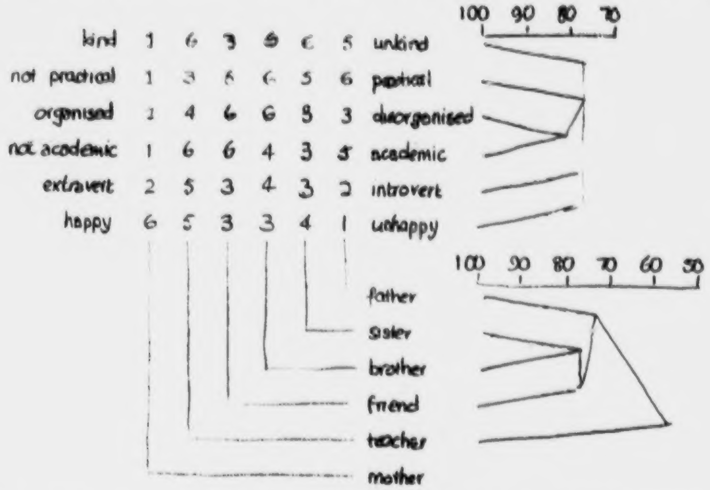
It should be stressed that these stages appear on superficial analysis and have not been subjected to rigorous testing. They also do not necessarily reflect all of the experts' responses. The next step will be to examine the steps in more detail and to explore the concept of the framework and its development. The skills which are used to build such a framework must be identified.

The second method used extensively in knowledge elicitation is observation. Because of the wealth of information that can be elicited in this manner requests for permission to videotape interviews have been made. This poses obvious ethical problems, and to date very few interviewers have agreed. However, some have, and the recordings will take place early in 1989.

Videotaped interviews will be analysed in two main ways:
a] content analysis - based on work originally by Otis & Daniels [1950]. Interviews can be analysed in terms of how long each participant speaks in relation to the other[s], and also in terms of what type of exchanges take place. It is proposed to compare interviews in this manner to gain a generalised picture of the interview content. Otis and Daniels concluded that this method was useful in training interviewees. This is accepted, given the qualification that the analysis of trainees' interviews should be compared to an idealised template, which can be obtained by this method.
b] interaction profiles - based on work by Bales [1950]. It is proposed that the construction of interaction profiles, at least of the interviewer will give an indication of the interpersonal skills and [verbal] communication processes employed by the expert.

The third major method of knowledge elicitation is based on personal construct theory. A full description of the theory is inappropriate here, and such are available in the literature [Kelly, 1955; Gaines & Shaw, 1981]. However the basis of the theory is that each person constructs a personal view of the world and uses it to predict events. The elicitation of a repertory grid involving elements [people or events] and constructs [bipolar concepts about elements] brings to light a person's view, and this can be focused into certain situations. So for example a grid can be constructed by an interviewer in terms of interviewees and how s/he viewed them. A repertory grid is an instrument designed to elicit information about how a person construes the world, in a systematic manner. Elements are chosen that are relevant to the situation. Three elements are chosen and a construct chosen that describes a similarity between two of the elements and the difference of the third. For example, three such elements may be the three family members father, mother, sister. A similarity might exist between the father and the sister, they are practical, the mother being at the opposite end of the pole. Each element is then rated on the construct, and the process repeated for several more constructs. This produces a matrix of ratings with elements on one axis and constructs on another. This matrix is an unrefined "map" of a construct system. For systematic analysis it is necessary to examine the ratings in detail to expose similarities in elements and constructs This is usually done using cluster analysis. The latter is the usual method. This produces two matrices of scores indicating how similar the ratings are for each pair of elements or constructs, and they are then clustered in terms of those similarities. Figure 1 is an example of a repertory grid after it has undergone cluster analysis. This figure was produced by a program developed by Shaw [1981], the latest version of which is called RepGrid. This is an integrated set of programs working on the Apple Macintosh, designed for interactive elicitation and cluster analysis of repertory grids.

Figure 1 Example of a repertory grid after cluster analysis.



kind	1	6	3	5	6	5	unkind
not practical	1	3	6	6	5	6	practical
organised	1	4	6	6	5	3	disorganised
not academic	1	6	6	4	3	5	academic
extravert	2	5	3	4	3	2	introvert
happy	6	5	3	3	4	1	unhappy

In order for a grid to be an accurate representation of how a person construes the world, that person must be able to accept that the final grid has not been distorted by the view of the person doing the eliciting. It requires experience to maintain such neutrality, and to convince the client that the constructs are not under debate. Gaines and Shaw suggest that when a computer does the eliciting, it is not suspected of having deeper motivations which could distort the outcome of the analysis. Hence the computer is viewed as a neutral interviewer more under control than a human. What is also evident during this investigation is that the computer has been of immense value in persuading people to take part. The experts contacted to take part are all professional people, and have had a reasonable amount of contact with computers in some form. Most have professed themselves "fascinated" by the operation of the program, and have been more willing to take part in this level of investigation than they have been to be videotaped. Another advantage to using the computer is the speed at which it produces the analysis, especially if compared to an inexperienced human tester. Due to this speed feedback can be given, in an attractive form, and quickly, allowing further refinement of the grid as necessary.

At present all the knowledge elicitation techniques being employed have proved useful, particularly the computer-based RepGrid. On superficial analysis of information gathered, it has been seen that the selection interview is a structured form of interaction which will lend itself to construction of a formal model. The final model and its transfer to a knowledge-based computer model is expected by mid 1989.

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EXPERT SYSTEMS AS A LECTURING SUPPORT TOOL

J.W. INNERD

ABSTRACT

A project to assess the use of an Expert System as a supportive aid to lecturing. Using Expert systems as a means of obtaining additional information and also providing practical exposure to Expert systems on a specific topic. The domain chosen being a mathematical model for a software selective criteria matrix. This paper explains the background and status of the project to date.

INTRODUCTION

The aim of this project was to develop an expert system as a tool to support a lecturing programme. In as much as the system would not only act as an information aid in a given topic area, but also, as a practical application of such systems. It was also hoped that this would give students the impetus to explore expert systems potential in other fields/areas.

The decision to use an expert system language and/or shell was made to give students access to expert systems which require no complex programming ability as a prerequisite. Therefore to allow "small, simple but powerful tools for the application of underlying techniques (of artificial intelligence) in commercial and industrial situations" (ref 1).

PROJECT OBJECTIVES

The major objective of the project was to provide practical experimental information on the applicability of using expert systems as a supportive role to lecturing. To this end the expert system chosen would have to be capable of being used as:-

i a vehicle for understanding the structure, nature and construction of such systems

ii a means of assessing the potential for such systems for practical use in the organisational environment

iii a mechanism to give additional information on the topic area/domain in operation and, in a limited way assess its capability as a pedagogy

iv a consolidation of i to iii above for use as a practical application for such systems

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KNOWLEDGE DOMAIN

To accommodate the objectives a narrow domain/topic area was selcted, one which was relevant to student requirements and suitable for the creating of knowledge base and inference pattern.

EVALUATION TABLE – WEIGHTED RANKING BY LEVELS SCORES

LEVEL	ELEMENT	WEIGHTS			ACTUAL WEIGHT	SUPPLIER A
		1	2	3		
1	HARDWARE	30				
2	CPU		30			
3	Speed			40	3.6	28.8
3	Size			60	5.4	43.2
2	DISKS		30			
3	Access Time			25	2.25	11.25
3	Capacity			40	3.6	28.8
3	Flexibility			35	3.15	25.2
2	INPUT		10			
3	Terminal Characteristics			50	1.5	12.0
3	Screen Size			50	1.5	12.0
2	OUTPUT		10			
3	Speed			40	1.2	9.6
3	Printer Width			40	1.2	9.6
3	Character Set			20	0.6	3.0
2	EXPANSION		20		6.0	36.0
TOTAL HARDWARE SCORE						219.45
1	SOFTWARE	45				
2	Systems		30			
3	Operating System			60	8.1	64.8
3	Programming Languayes			25	3.375	27.0
3	Utilities			15	2.025	16.2
2	APPLICATIONS		70			
3	Sales Order Processing			35	11.025	88.2
3	Sales Invoicing			5	1.575	12.6
3	Stock Recording & Control			35	11.025	88.2
3	Sales Ledger & Sales Analyses			5	1.575	12.6
3	Purchase Order Monitoring			5	1.575	12.6
3	Purchase Ledger & Purchase Analyses			5	1.575	12.6
3	Nominal Ledger			5	1.575	12.6
3	Payroll			5	1.575	9.45
TOTAL SOFTWARE SCORE						356.85
1	SUPPORT	15				
2	Training		20		3.0	24.0
2	Maintenance		35		5.25	42.0
2	Systems Support		35		5.25	42.0
2	Back-up		10		1.5	12.0
TOTAL SUPPORT SCORE						120.0
1	GENERAL	10				
2	Installation Requirements		15		1.5	12.0
2	Documentation		5		0.5	4.0
2	Implementation Plan		30		3.0	24.0
2	Delivery		10		1.0	8.0
2	Working Relationships with Supplier		30		3.0	24.0
2	Market Position of Supplier		10		1.0	8.0
TOTAL GENERAL SCORE						80.0
GRAND TOTAL SCORE						776.3
POINTS/£1000						17.13

Figure I

The Weighted Ranking Scores (WRS) methodology was chosen as the model, this provides a relatively straightforward mathematical model, containing a well structured format of data, relationships and methodology for computing and assess realistic results.

Figure 1 shows the WRS basic relationship of factors and weigh ratios used for relevant selection criteria in questions. "Supplier A" represents a computed score for an individual entrant.

In the proposed full system, multiple suppliers will be available and a comparison algorithm included for "best" supplier indication.

The term Supplier is used here to represent not only a software manufacturer/dealer offering many computer items, but can also be used to imply comparison between similar software/hardware applications.

The criteria and weighting will be dynamic, the system structure will be constructed through a preparation session.

SYSTEM DESIGN

In selecting an appropriate system to statify the objectives, several important factors and practical limitations had to be considered, these fell into two areas of constraints:

a) Internally - content of knowledge base, inference and domain logic
- rule structure in inter-relationship/action

b) Externally - user interface, level of student computer awareness and programming ability

To satisfy the internal constraints the WRS topic was chosen as discussed above, i.e. understanding structure, relevant topics. The external constraints of computer awareness etc. an expert system shell/model building package was selected, SAGE level 1.3 (ref 3). Although this is a relatively old system it was available on the PRIMOS (ref 3) operating system and easily accessable and familiar to students in question. The SAGE system does offer sufficient functionality to allow the building of the desired systems

ie - allow interactive dialogue.
- assess likelihoods and probabilities and reasoned alternatives.
- provide justification and explanation.
- offers limited stereotyping/franking (via related question/topic groupings).

PROJECT STATUS

The project to date consists of a pilot system which has been constructed to evaluate a single supplier under WRS, providing the knowledge and rules therein. In relationship to the objective initially planned, the production of logic trees to explain rules, relationships and computations has provided important additional information to students of the topic of software selection. It has also been useful as a demonstration of an expert system, in terms of construction and practical execution of such systems.

However, at present the user interface to the system is such that it is not a self sufficient system by which students can access/understand the subject matter. Without suitable preparation on the system the interactive dialogue does not provide enough explanation and justification for criteria and relational logic.

Generally the students find the system of interest as means of practicing executing WRS, but as this cohort has received both formal and expert system based instruction on WRS it is difficult to judge its value.

It is planned to use this system as the only access for students to this topic and assess their comments and knowledge attained.

To allow the facility of multiple suppliers, the problem of interaction and interface it is expected that a new version or system will have to be used for future investigations into the practicality of expert systems as a supportive tool.

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A SIMPLE A.I. EXPERT AUTHORING SYSTEM OR WANT TO BE A KNOWLEDGE ENGINEER?

G.P. Jacobs*.

ABSTRACT

A discussion of the nature and use in education of an Artificially Intelligent (A.I.) Expert System will be given. This will include a working sample that analyzes an educator's teaching style and recommends other (CAI) authoring systems for the individual to use. A freeware A.I. Expert Authoring System Tutorial (disk) will be available to the audience.

Introduction

While delivering a presentation at the Florida Instructional Computing Conference in 1985 on Selecting A Computer Assisted Instructional (C.A.I.) Authoring System using a mechanical device (flowchart system with a self needs assessment), it became apparent that a better selection method was needed. Just as a medical doctor would not prescribe for himself, the average educator cannot be expected to realistically self-analyze his teaching style and prescribe suitable procedures and developmental tools for his own use.

An "expert" system was the answer to the problem. This form of A.I. contains a powerful diagnostic/prescriptive ability. Any individual involved in repetitious testing can benefit from this system. The more difficult the test or scarcity of testing administrators, the more valuable this system.

PROCESS OF SELECTION

While any language that possesses recursion could be used to accomplish this task, its approximate development time of two years is unacceptable in an educational setting. An authoring system that was economical to purchase and use was needed. It had to be straight forward in its ability to compose material and fast in execution (run time). These features would leave the author or "knowledge engineer" free to concentrate on the design of the diagnostic/prescriptive rather than the intricacies of coding (programming a language). Time to research the problem, locate similar works, refine the questions, branch the responses, and test the product would now be available.

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OPERATION OF THE AUTHORING SYSTEM

The authoring system chosen had all of the prerequisite features with the addition of an interesting editing feature. The "knowledge engineer" could choose the editor enclosed with the system or one of the popular word processing programs in the non document (ASCII text) mode. It used simple if...then... statements to process answers to questions and "branch" them to appropriate sections of the system including additional questions, text screens with diagnosis/prescriptions, help screens to "expand" on the meaning of the question, or to an electronic conclusion section that rated the percentage of confidence the system had in a conclusion.

The best feature was the ability of the "expert" system to show exactly why it reached a conclusion. It would, upon request, show the questions asked, answers given, and relative confidence in each answer as related to a specific line of questioning (goal). This allowed the more sophisticated client to analyze the results for both validity and reapplication of the program.

THE AUTHORING SYSTEM TO USE

Insight 1.2 from Level Five Research (now Information Builders), 503 Fifth Avenue, Indiatlantic, Florida, 32903, was the authoring system used. It had an "educational" discount price of $47.50 with run-time copies available for five dollars each. Today you can use the same company's more powerful "freeware" tutorial system to learn about authoring an "expert" program. The "freeware" contains a forty-one page book of instructions (on the disk) plus an on-line tutorial as you compose your own sample "expert" program --- a free adventure. If you are interested in the full program please contact Information Builders about the new Level 5 Expert System Software at the above address. Another system that is not as economical, but very enjoyable, (yes, it was fun!) to use was Personal Consultant "Expert System" by Texas Instruments, Dallas, Texas.

FREEWARE

The Level 5 Tutorial "Freeware" will be made available at the conference after this author's presentation. Those wishing to see the old CAI report with flowcharts may also contact us at the conclusion of the session for a copy.

INTEGRATING CLASSROOM LEARNING AND CAREERS.

P. B. Martin*

ABSTRACT

Adult college students can learn to integrate what they learn in the classroom and what they learn through career development activities in such a way that when they graduate they are considered knowledgeable, competent and effective by prospective employers. Students who engage in these integrating activities tend to become more confident, feel empowered and express a greater satisfaction with their college experience than other students. The integration of learning tend to be more effective when various video and computer technologies are utilized.

INTRODUCTION

Too often adult college students are educated in a fragmented fashion. Teachers teach, counselor counsel, administrators administrate and technicians technologize. The students are often left on their own to try to interpret all these experiences so that meaningful learning takes place and they can move ahead successfully.

The Career Planning Program at Hostos Community College (a bilingual comprehensive community college in New York City's South Bronx area, with an enrollment of 4500, mostly adult students who are recent USA immigrants) has developed an integrated approach to fostering effective learning. It does this by utilizing various educational technologies and by working cooperatively with the academic faculty in the English and Business Departments: (1) to establish learning objectives that would be reinforced by the Career Planning staff (career counselor and placement officer), (2) to assess the attainment of these learning objectives, (3) to utlize various technologies (computer hardware and software, and video technologies) creatively for students and faculty, and (4) to help students refine and attain the goals they have set for themselves.

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CAREER DEVELOPMENT ACTIVITIES

Students who register for employment or for career counseling are assisted to develop their learning skills in all the activities sponsored by the Career Planning and Placement Program.

Activities (such as resume development, preparation for job interviews, referral for employment and vocational assessment) are treated as learning opportunities, and learning objectives are specified for each.

These learning objectives, or performance objectives, are used by both students and faculty to assess the effectiveness of the activities and the students' progress. Students are encouraged and assisted to assess their own progress and to determine what else they must learn to feel truly effective when meeting prospective employers.

Peer support is utilized to provide feedback to students, to assist in using various learning technologies such as video, computer-assisted career planning and in resume development and preparation.

The career planning staff has deliberately and carefully used "helping behaviours" to create a learning environment in which risk-taking and failure are acceptable, in which individuals feel emotionally supported, and in which new learning is encouraged and rewarded.

RESULTS

As a result of this approach and using various learning technologies in career activites, students have expressed an extremely high level of satisfaction: over 90% indicate significant learning by using computer-assisted career planning materials; over 90% indicate significant learning after the completion of a two-credit career planning course; over 75% have demonstrated that they can produce an acceptable computer-generated resume after only two sessions with a career counselor (for most it was their first attempt at producing such a document); employers have increased their recruitment of Hostos Community College students (a 300% increase in three years), and nearly 10% of students who participate in career day activities are given job offers.

SUMMARY

As we move towards the Twenty-First Century and move into a post-industrial society, the need for citizens to become skilled, flexible, creative and self-assured becomes ever more evident (ref 1). As we examine the effects of long term unemployment and under-employment, we see the need to help our community college students to develop the interpersonal networks, the self-presentation skills and the technical skills to become so self-dependent that they can move easily and successfully into the new high tech society. These learning objectives are more easily and securely attained when they are specified, planned for and involve the integration of classroom learning and career decision-making learning.

1. R. Wegmann, R. Chapman and M. Johnson, Work in the New Economy (JIST Works, Indianapolis, IN, 1988) p 242-252.

DO COURSES NEED AN INFORMATION TECHNOLOGY STRATEGY?

Graham J. Worsdale

ABSTRACT

The arguments for and against the inclusion of Information Technology in Business, Accounting and Public Administration type courses have been well rehearsed; in print, for example (1), at conferences, for example (2), and during the processes of course development/validation/review. This article aims to examine the need for courses to develop an IT strategy in the same way that organisations are developing an IT strategy as part of their overall organisational strategy.

THE "COMPUTERISATION" OF ORGANISATIONS

The late 1960s and 1970s saw the realization by many large and medium sized commercial, industrial and public sector organisations that many of the systems they used for paying employees, ordering materials, monitoring stock levels and dealing with clients required significant clerical effort and that the systems were amenable to "computerisation". Thus by using an appropriate methodology or systems development cycle (3), these systems for dealing with transactions were computerised. This was normally accomplished "bit-by-bit" giving little or no thought to the overlap between one type of transaction and another and, commonly, resulted in a wastage of resources.

During the late 1970s and the 1980s the bringing together of the potentials of computer and telecommunications technologies to give, what has come to be known as information technology plus the development of "business" software has given organisations the tools to aid their planning and monitoring in addition to performing the necessary organisational transactions. It is now recognised that IT has the potential to give organisations competitive advantage and improve the service to their clients (4 and 5). Thus, as part of their overall strategy, organisations are developing an IT strategy. The strategies should not be departmental led, as this may lead to a waste of resources, but, first and foremost, must involve an analysis of what an organisation is doing now and what it may want to do in the future. Porter and Millar (4) conclude:

> "The importance of the information revolution is not in dispute. The question is not whether information technology will have a significant impact on a company's competitive position; rather the question is when and how the impact will strike.

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> Companies that anticipate the power of information technology will be in control of events. Companies that do not respond will be forced to accept changes that others initiate and will find themselves at a competitive disadvantage."

COURSES AND IT DEVELOPMENT

During the late 1970s and early 1980s computer terminals and then micros started to arrive in faculties and departments associated with business and management education. Initially they were put to the use of teaching students to program. This type of work sat comfortably alongside the data processing giving it a "practical dimension" and it helped to answer questions posed by validating bodies on the students "hands on" experience.

The development of in-house Computer Assisted Learning Packages in a variety of subjects started to occur. They were, and still are, expensive to develop but were also useful to discuss during validation procedures. During the 1980s reasonably easy to use accounting and statistical packages have become available together with the spreadsheet, database, graphics and wordprocessing packages at reasonable prices. "Bit-by-bit" the students on our courses are being developed in the use of some, if not all, of this type of software. However their use and application is determined by the aims and content of a particular unit or module and, possibly to a greater extent, by the individual member of staff responsible for a unit during that particular session.

Hence the development of IT within our courses has, like in many organisations in the 1970s, been piecemeal and is commonly used for transaction work. While a course may have as one of its general aims the introduction of IT skills and knowledge, do courses plan and coordinate IT? Given the worsening resource situation both in terms of manpower and finance for equipment it is necessary for courses to develop a strategy for IT content and its implementation.

A WAY FORWARD

Just as organisations are having to develop a strategy for IT a course team must be capable of identifying:

> the relevance and importance of IT to students on the course and to their likely future careers.

Building upon such a policy statement the course team should be capable of indicating the "courses" view in more detail on the relevance and importance of items such as:

- Use of hardware and general purpose software.
- Organisational information systems: their purpose and development.
- Use of IT tools as used in organisational decision making processes.

- Effects on the organisation, its employees and its clients by the introduction/development of IT.
- Social and legal framework in which IT developments take place.
- Technological developments which will effect the future operation of an organisation.

Having identified content the course team needs to

(a) decide on a policy of implementation which will minimise, or possibly eliminate, overlap thus making more effective use of resources,

(b) quantify the facility requirement for the course; hardware and software, both in class and out of class now and in the future,

(c) identify the staff development needs in order to (at least) maintain staff awareness of IT developments and their ability to deliver the skills and knowledge to students in the most effective manner.

CONCLUSION

The article has attempted to show that the development of IT within courses should be similar to the development of IT within organisations and that courses should have a strategy for IT. Without such a strategy it will be difficult, if not impossible, for courses to justify their future resource needs in the area of IT. Inadequate resourcing is likely to lead to a course losing its credibility and its market.

Thus if a course is to survive in what is likely to be a more competitive market the course must have a strategy for the role of Information Technology within the curriculum.

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QUALITY ASSURANCE IN TEACHER EDUCATION: TECHNOLOGY APPLICATIONS

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ABSTRACT

A model program has been developed which reflects the state-of-the-art capacity to design, develop, analyze and disseminate information about the performance of students relative to their teacher training preparation. Using mainframe and microcomputers, optical mark reader (OMR) scanning equipment, VCR players, and a combination of specific and generic computer programs, students are monitored from admission to teacher training programs through the first contractual (provisional) year of teaching. The system has been instrumental in determining weaknesses in specific curricular areas, and has led directly to modification of the curriculum to strengthen those areas.

INTRODUCTION

As an outgrowth of the teacher reform movement, the College of Education and Psychology at the University of Southern Mississippi (USM) applied for and received a grant from the U. S. Department of Education, Office of Educational Research and Improvement (Contract Number 400-85-1064) to establish a model which would lead to monitoring of student performance and to curricular reform in teacher education. The system which was borne from this funded project was founded on the premises associated with educational accountability and improved public education. In order to bring the greatest degree of relevance to educational accountability, the system herein outlined has been developed to monitor the goals and

Fig. 1 State mandated competencies

I. Plans instruction to meet selected objectives
II. Organizes instruction to take into account individual differences among learners
III. Obtains and uses information about the effectiveness of instruction to revise it when necessary
IV. Obtains and uses information about the needs and progress of individual learners
V. Uses instructional techniques, methods, and media related to the objectives
VI. Communicates with learners
VII. Demonstrates a repertoire of teaching methods
VIII. Reinforces and encourages learner involvement in instruction
IX. Demonstrates an understanding of the school subject being taught and demonstrates its relevance
X. Organizes time, space, materials, and equipment for instruction
XI. Demonstrates high expectations for learners' academic performance
XII. Demonstrates enthusiasm for teaching and learning and the subject being taught
XIII. Helps learners develop positive self-concepts
XIV. Manages classroom interactions

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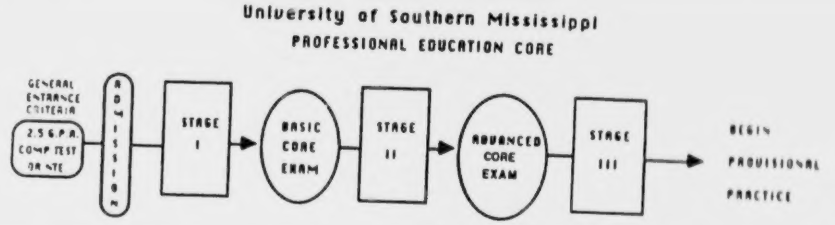
This publication is based on work sponsored wholy or in part, by the Office of Educational Research and Improvement, U.S. Department of Educaqtion, under contract number 400-85-1064. The content of the publication does not necessarily refect the views of OERI, the department, or any other agency of the U.S. Government.

objectives established as important to beginning teachers through a continuous, consistent follow-up process. The three-year contract began with an assessment of the status of the curriculum in teacher education at USM, which led to the linking of the curriculum with the Mississippi State Department of Education provisional teacher certification program. The provisional certification program requires that teachers, within their first three years of practice meet fourteen predefined competencies as outlined in Figure 1, prior to moving to the status of permanent or professional certification. In order to assure that the graduates of the USM teacher education program meet these state mandated competencies, it was necessary that a complete, in-depth review of the curriculum be inaugurated to determine that those competencies were in fact extant within the curriculum. After initially modifying the curricular structure to ensure the presence of instructional variables to master the state competencies, it was apparent that a monitoring system be established to track the progress of students through their learning and induction into teaching.

METHODOLOGY

A series of three steps as displayed in Figure 2 were defined around which the monitoring process was to occur. In step one, students were admitted to the teacher education program based on the completion of prerequisite requirements for admission. A file on each student was opened in a data base, which was accessed interactively with registrar's office files maintained on the mainframe computer at USM and on microprocessors housed in the Dean's office in Education and Psychology. After completion of a number of courses, of which four were defined as Professional Education Core courses, students attempted the Basic Core Examination (BCE), a criterion referenced examination designed to measure knowledge level factors associated with the state-mandated teaching competencies. Software written specifically to archive, retrieve, write, score, and report the BCE was developed internally within the college. The software was indigenous to the microprocessors in Education and Psychology. Concurrently, optical scanning forms, intelligible to an optical mark, reader were developed to collect information from the BCE.

Fig 2.


University of Southern Mississippi
PROFESSIONAL EDUCATION CORE
GENERAL ENTRANCE CRITERIA
2.5 G.P.A.
COMP TEST
OR NTE
ADMISSION
STAGE I
BASIC CORE EXAM
STAGE II
ADVANCED CORE EXAM
STAGE III
BEGIN PROVISIONAL PRACTICE

Once the BCE had been mastered, students were admitted to the second level of the teacher education program, the advanced core. At this level, students completed all remaining coursework leading to a bachelor's level degree in education. This coursework included an innovative five-hour block of coursework designed to ensure mastery of the fundamentals of the state mandated competencies. Students were given specific training in the evaluation process of the assessment instrument by which they would be evaluated. After completion of this process, students attempted the Advanced Core Examination, an examination in which they had to rate the performance of other teachers using the assessment instrument by which they would be judged during their provisional year(s) of certification. After completion of the advanced core, and mastery of the examination, students were approved for the student teaching experience during which they were subjected to two complete assessments using the instrument by which they would be judged the following year. In both the advanced core and the student teaching experience, software was developed, to monitor and evaluate the performance of students; and data were collected by means of OMR sheets.

To date, 181 students have completed at least part of the process. No data are available for the final, provisional certification step. These data will become available during the 1989-1990 school year.

RESULTS

Results of the effort reported here must of necessity be of two types. Some empirical data can be displayed which relates to course content mastered, as reflected by the competency measurements. Secondary results relative to the function of and benefits derived from the implementation of the innovations must necessarily be narrative in nature. Table 1 reflects academic performance of the BCE portion of the training program. Consistent, statistically significant results were found to exist on pre- post- test measures of competency knowledge on six of the competencies measured. On the remaining seven competencies, no significant change was found, although change in mean scores was, in each case, in a positive direction. Two probable explanations of the weak results suggest themselves. First, it is possible that the academic content of a number of educational competencies is generic in nature to the extent that this information is not improved as an outcome of instruction. Second, the degrees of freedom in the pretest measures of the nonsignificant findings were so restrictive as to make tests for significance difficult to come by. In the first case, further curricular review and potential modification is suggested. In the second, time and an ever-increasing n will provide an answer to the question.

Table 1 Summary of Results of Pretest-Posttest Comparisons--BCE

	Pretest			Posttest				
Measure	Mean	Var.	N	Mean	Var.	N	t	p*
Competency								
I	8.38	3.45	16	9.30	2.94	164	2.16	<.03
II	4.46	1.22	20	4.96	0.85	164	2.58	<.01
III	5.33	0.61	12	5.47	0.48	164	0.65	
IV	4.17	0.70	12	4.63	0.76	164	1.80	<.05
V	4.58	1.36	130	5.20	0.75	164	5.19	<.01
VI	----	----	---	----	----	---	----	----
VII	3.34	1.72	32	3.63	1.15	164	1.35	
VIII	9.33	1.52	12	10.05	1.54	164	1.95	<.03
IX	4.42	1.36	12	4.55	0.79	164	0.49	
X	3.42	1.17	12	3.73	0.68	164	1.25	
XI	9.67	2.61	12	9.96	1.77	164	0.72	
XII	3.17	0.52	12	3.18	0.40	164	0.09	
XIII	4.39	0.91	28	4.63	1.34	164	1.02	
XIV	5.32	0.97	28	5.56	1.27	164	1.07	

Table 2 provides capsular data regarding the number of students who have passed through each phase of the program since the curricular revision has occurred. As can be seen from the tendency toward increasing enrollment, two factors are evident. No apparent negative outcomes relative to student recruitment have occurred as a result of the revised curricular structure. In addition, the ever-increasing numbers of students in education mandate the use of electronic technology to provide the most efficient and available data from which to continuously monitor progress. It appears, as the real-time monitoring of student progress continues into its third year, that the decision to commit resources to the technological aspects of the program are well founded. With the magic wand of new technology, the administration is able to determine which aspects of the education of students, and the flow of students through the education programs are in greatest need of direction and modification.

Table 2 Individuals completing each phase of the curriculum

	Sum 87	Fall 87	Spr 88	Sum 88	Fall 88
Declare TE	*343*	*368*	*381*	*439*	*538*
Admissions	*346*	*393*	*332*	*468*	*362*
Fail BCE (1)	*5*	*4*	*8*	*2*	*7*
Fail BCE (2)	*0*	*4*	*3*	*5*	*2*
Fail BCE (3)	*0*	*0*	*0*	*0*	*1*
Pass BCE	*112*	*93*	*124*	*186*	*143*
Fail ACE	*0*	*0*	*0*	*0*	*0*
Stu. Teaching	*82*	*111*	*178*	*228*	

THE COMPUTER : "AN ADMINISTRATIVE TOOL"

Michael Zolkoski*

Abstract

Today's leaders must be able to demonstrate an understanding of the technology and educational trends of computerization that will influence their future decisions. Computers in the educational settings have various administrative applications. Administrative offices in today's world will need the availability of quality software to increase their efficiency and effectiveness. Effective uses of the computer in the administrative environment will enable the administrator to make strategic accomplishments. The computer will be the tool of the future for all administrators who are effective and precise.

Introduction

Several important decisions need to be made prior to the selection of a computer system. The purchase of hardware is an essential part in developing a computerized system that will produce efficiency and effectiveness. One of the main considerations that is sometimes overlooked is the availability of software for each different system. A computer system of this magnitude must have "compatibility" with all software applications to be effective. The most important question to ask in establishing an efficient system is that of compatibility. Individuals who overlook this aspect find themselves in a situation that has no compromise. Hence, we will glance at administrative software applications that can be helpful in the day-to-day operations of education administration.

Computer Software Applications

The first software packages to enter the marketplace were those of word processing. Several good software packages started the word processing market. Scripsit, along with several simple word processing packages, was the first to open the software market. As the market evolved, software companies took over the software market and replaced hardware companies that marketed software only for their computers. As early as the 1960's, compatibility was just an idea that companies refused to acknowledge. Today, a software company has to offer several types of packages that are compatible with different computers. Microsoft has used Word as its leading processor for years. Several versions have been developed to allow the ability to incorporate this software with other packages. The one that has emerged as the leader has been WordPerfect. Last year, this company held the number one sales spot in the word processing field. This software package contains several notable advantages.

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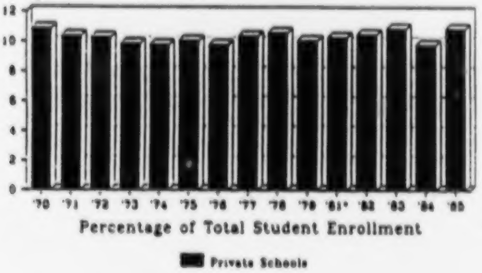
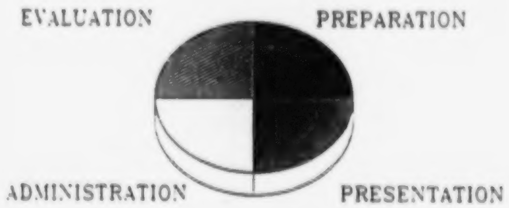
First, the support of the software has always been one of my basic concerns. WordPerfect has established several programmers and analysts who answer phone calls daily. This trouble-shooting support system has allowed this growing company to become successful. Adaptations to the Apple, as well as other computers, has made this company a leader in word processing. Another improvement in its recent 5.0 version is the incorporation of fonts and graphics packages. Wordperfect has combined some of the features used in Pagemaker and Multimate into its new product. Even though to some individuals WordPerfect is perceived to take more time to understand the different function keys, the overall speed and power of this program is accomplished through this patience. Another concern in selecting word processing software is the priority of file management. The management of files inside a program can be complicated after one starts to gain access to similar files. WordPerfect automatically sets up directories and sub-directories for easier access to each file. File information and length will be needed in categorizing files for merging in most cases. Expansions to other software packages and databases allow this program to remain on top of the software market. Support services and file management will become your best friends with this program.

In looking at databases, one can again see the flooding of the software packages into the market. Database III, PFS:File, and many other packages have encouraged administrators throughout the nation to familiarize themselves with the uses of databases. One database that has been overlooked is that of Filepro 16. Filepro 16 and Filepro 16 plus were programs that were developed over the past few years. Filepro 16 was developed by the Small Software Company in Delaware four years ago. This program basically expanded Profile III and Profile IV plus versions. Programmers have learned over the years that administrators have different needs for databases that will ensure quality output from their collected data. Generic style of databases is now a common occurrence among many software companies. Educational institutions need the flexibility to develop their own database.

The alternatives to these generic programs is to hire a programmer to develop a customized database. This decision will usually cost the consumer an unreasonable price for the programming services. Filepro 16 permits the individual to build a comprehensive database that can process more than 100 sorts. Customized menus can be developed to suit each school district or even become departmentalized within a large school district. Reporting of test scores, immunization records, college information, schedules, attendance, grades, and many other valuable segments of data can be sorted and printed for the required state agencies or individualized requests. The key in selecting databases today is that one must insist they be flexible and usable.

Another field that has intrigued administrators is that of the graphic presentation. School district presentations can now be enhanced by the use of graphics in their delivery. Several software packages are available in this field. The program that I prefer is the Harvard Graphics package. Several features, such as graph transformations, merging of Lotus files, and colorization of charts have been my favorites. Bar graphs can instantly be changed into line graphs with just the touch of a keyboard. Harvard Graphics allows one to build customized graphs and charts to illustrate points of concern or progress reports. Merging the data from Lotus files into this graphics program permits one to build charts and graphs without installation of the data. As one can see in the figures below, charts can easily be established. Announcements and memos that require different font sizes can be custom-made at one's discretion. Harvard Graphics has replaced some of the less expensive desktop publishing programs that are limited in scope. One must use this program to gain the appreciation of its power.


Private School Enrollment
Trends K-12: 1970-1985


THE SCHOOL BUDGETING CYCLE
A CONTINUING PROCESS

In reviewing the uses of spreadsheet, one must remember that not long ago school districts were using extra-long ledgers to balance their accounts. Spreadsheet have simplified the process accountability in school districts today. Products such as Lotus and Excel are now a way of life in the business operation of school districts. Having used both programs, I find that I still prefer Lotus for two main reasons. The support of the Lotus program is universal throughout schools, and file interchanging between schools and between districts is possible. Importing of Lotus files into programs such as WordPerfect and Harvard Graphics allows one to produce products that are far superior because of the capability of merging. Cell configurations that allow a single cell change can deliver a complete analysis of data in a single stroke. Lotus has established itself as a reputable product in the market today. Lotus also contains a database that has been helpful to many. The database is limited because of its fixed sorts and locations of file information, but it does have applications such as regression tables. Of all the programs needed today, spreadsheet are probably the most widely used. Economic hardships and the failing economy will require school districts to produce extended analysis of budgets with a basic emphasis on salary analysis. An administrator needs this tool for the ever changing world of school finance.

Conclusion

Three rules must be followed in selecting computerized software in the future. The first concern must be that of compatibility. Compatibility has been an issue that has not been solved by the computer world. Eventually, software will need to be universal in nature and will be required to have only one version that can run on any type of computer. Current transitions, such as Apple boards and MS-DOS boards, will no longer be required. Computers will be built to run any kind of software; universal software will become a reality for administrators in the future. The second thing to remember is the ever growing need for software support. Support of software packages is a necessity and should be studied thoroughly before one purchases software. All too often, individuals buy software that has no support. Some administrators have even purchased software that contained required service charges. Most top software companies will supply individuals with support phone numbers and suggestions for different versions of their product. And finally, one should remember the overall cost and the reputation of the software company. Costs must include support charges and possible update version expenses. Modem correction requirements must also be discussed prior to the purchase of this software.

The administrator must not only be able to select the appropriate software packages, but also possess skills to operate and understand these programs. The administrator who uses these computer applications correctly will be effective and efficient.

CROSS-DISCIPLINARY INVESTIGATION OF DEVELOPMENTAL PRIORITIES FOR ADMINISTRATIVE AND INSTRUCTIONAL COMPUTING POLICY ISSUES

Brent Edward Wholeben†

ABSTRACT

A study of N=793 professional educators from a three-state (USA) region demonstrates significant differences in perceived priorities for specific objectives related to education policy in administrative and instructional computing. The disciplines investigated were: (a) language arts (including reading), (b) mathematics, (c) science, (d) social studies, (e) special education, (f) economics, and (g) interdisciplinary. Respondents identified their top-20 priorities for policy objectives from an initial list of 52 objectives; then, selected a list of top-10 priorities from the secondary list of 20 objectives. Lastly, each of the top-10 selections were ranked (1-10). Between-disciplinary main effects were significantly ($p \leq .05$) related to top-20 issues concerning curriculum, access privilege, teacher responsibilities, community involvement, and software resources. When selection is restricted to a top-10 priority list, interdisciplinary opposition is reduced, and overall differences between single disciplines in determining policy priorities diminished.

INTRODUCTION

The International Council for Computers in Education released in 1987 the Code of Ethical Conduct for Computer-Using Educators, a comprehensive statement on ethics and equity in educational computing comprising 52 separate guidelines related to curriculum, access, privacy and confidentiality, teacher, student, community, organization, software, and hardware. Would these guidelines be accepted by the education profession? Which issues would be considered sine qua non requirements? Which statements might be relatively unstable during periods of constraint? What differences might be contrasted among educators who represented different disciplinary and subject matter foci?

This paper presents the results from an initial stratified random survey of K-12 professional educators (N=793) representing the differentiated subject areas of: (a) language arts (including reading) (n=64), (b) mathematics (n=40), (c) science (n=40), (d) social studies (n=37), (e) special education (n=37), (f) economics (n=25), and finally, (g) interdisciplinary (n=550). The data collection instrument was self-disclosing by respondent. First, to establish an initial priority ordering, each respondent selected 20 of the available 52 statements as perceived requirements for a comprehensive policy on computing ethics and equity. Second, to simulate an artificial environment of imposed general (viz. undefined) constraints, each respondent selected the top-10 of these initial 20 components.

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ANALYSIS

Differences in policy priority perception were analyzed statistically utilizing contingency table analysis and the chi-squared statistic. A significance level of $p \leq .05$ was deemed acceptable *a priori*.

FINDINGS

Interdisciplinary trained educators strongly disagreed with the priorities of their single disciplinary colleagues, particularly in issues related to access privilege and teacher rights and responsibilities. The greatest amount of conflict was recognized for science teachers who can be expected to receive support from their special education and economics education counterparts. By contrast, mathematics educators can be expected to support a cross-disciplinary policy. Language arts faculty will gain support from mathematics educators for their curricular priorities in the constrained setting, but can be expected to lose support from special educators and more interdisciplinary educators for policy related to teacher rights and responsibilities. (Refer to Table 1.)

DISCUSSION

Unconstrained Policy Development

Eight (8) policy objectives were found to be in dispute across disciplines when policy development was relatively nonrestricted:

01 When appropriate provide teacher training for integrating computers into the curriculum and for the changes in curriculum that computer use brings.

02 Support and encourage equity among schools in terms of availability and breadth of use of computer technology.

03 Attempt to provide curriculum materials for computer use that will have meaning and appeal to all learning styles.

04 Include planning for equitable management of computer resources.

05 Give attention to teaching students the ethics of computer use.

06 Participate in the selection of computer use goals.

07 Provide training to members of the educational or general community when asked and when practical in order to encourage parental involvement in long-term planning of computer use.

08 Discourage and refuse to support unauthorized duplication of printed material related to copyrighted software.

Constrained Policy Development

When policy selection was restricted, five (5) policy objectives were found to be in dispute across disciplines:

01 When appropriate provide teacher training for integrating computers into the curriculum and for the changes in curriculum that computer use brings.

02 Strive to see that all students have equal access to computers and computer related experiences. I will see that students have such access no matter what their academic potential, ethnicity, gender, socio-economic group, or special education status.

03 Strive to obtain teacher training appropriate to needs for classroom use of computers.

04 Participate in the selection of computer use goals.

05 Encourage, through purchasing decisions, those vendors who make reasonable provisions for backup copies and multiple access.

RELATED FINDINGS

When interdisciplinary influence is excluded from the analysis, a vastly different profile of support and conflict can be developed between the single disciplines. The emphasis on teacher rights and responsibilities is reduced to a single issue, with a formation of new alliances between disciplines regarding specific policy objectives. When priority selection is restricted, these alliances likewise reform to product new anticipated conflicts.

Table 1. Summary of unconstrained and constrained policy priorities based upon a variable disciplinary foci.

	LARG	MATH	SCIE	SOCS	SPED	ECON	INTR
Unconstrained Policy Development							
(teacher training for use and change)°	+					-	
(equity among school campuses)			+		+		-
(equity among learning styles)			-	-			
(resource management)			+				-
(specific instruction in ethics)					+		-
(participatory planning - teacher)°	+		-		-		+
(participatory planning - community)			-			-	
(documentation duplication)			+				

	LARG	MATH	SCIE	SOCS	SPED	ECON	INTR
Constrained Policy Development							
(teacher training for use and change)°	+	+					
(equity among student users)	-			-			+
(pre-utilization training)			-	-			
(participatory planning - teacher)°	+		-			-	
(vendor flexibility)			+				-

LARG (language arts and reading)
MATH (mathematics)
SCIE (science)
SOCS (social studies)
SPED (special education)
ECON (economics)
INTR (interdisciplinary)

+ significantly high ($p \leq .05$) priority for policy item

- significanty low ($p \leq .05$) priority for policy item

° retained priority under artificial constraints

ROBOTS AS EDUCATIONAL TOOLS

Erich Neuwirth

ABSTRACT

The availibility of reasonably cheap and quite powerful robotics kits gives the opportunity of easily combining hardware and software issues in learning about computer. We will attempt to discuss possible inclusion of robotics concepts into the general curriculum of teaching computer science concepts and applications.

GENERAL CONSIDERATIONS

For some time now educational robotics devices are available. They have not so far had a major impact on education on a broader scale, they have only been used in specialized projects. Given the impact robots have on the professional life of rather many people we should try to conceive strategies to implement learnig about robotics in the school system for all the students who will have contacts with robots later on in their career. But since the educational system not only has the task of training people for their professional life but also supplying them with fundamental skills for living in our civilization the task of furnishing them with basic knowledge about robotics both from a practical and a theoretical viewpoint may become quite important in the near future. Therefore we will analyze briefly what is available and then we will consider in some detail what educational uses can be made of the devices at hand.

We can classify the available devices according to more than one point of view:

1. Hardware point of view:
Complete self-contained robots or open systems. Self-contained robots usually can be bought completely assembled, but in some cases they also can be bought as kits. Open systems have to be bought in kit form. Usually such kits offer the main modules for robotics (like stepper-motors, switches, gears and different kinds of sensors) and instructions to assemble different kinds of devices using these functional modules.

2.Control mechanism point of view:
The controlling program can be resident in the device itself or the device can have to be connected to a computer system performing the logical decisions necessary to run the device.

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3. Software point of view:
The necessary programming logic may be supplied "ready-made" or it may be the main task for the students working with the kits to develop the programs necessary for a robot to perform a given task.

Now given these different approaches to using robots let us analyze the aspects connected with implementing educational robotics projects.

If the main task of a project is just to make students acquainted with robot technology using as complete and already working systems may be the most time efficient-strategy. The disadvantage of this approach of course is that the student essentially is trained to become a consumer of robotics products and he will not accomplish any competency or deeper understanding about the basic rules making such devices possible.

The educational situation may be better if the student uses ready-made hardware, but has to plan the software control strategies in this case. There exist simple robotics devices which are user-programmable but autonomous. This offers the great advantage of not needing any additional devices, but the disadvantage is that robotics is experienced as a self-contained discipline and hardly any connections to other activities may be seen. But if no other hardware or software resources are available this may be a sensible strategy from a pragmatic point of view.

If robotics projects are not under heavy time constraints it may be a wise idea not only to develop the control but also to assemble a robot by using physical modules offering different functional modules. An important aspect when doing such projects would be to construct more than one robot, thereby demonstrating that the same basic set of functional modules can be used to perform different tasks.

If microcomputers also are available to the students we can use robotics devices which can be connected to these computers via an interface box and where the computers perform all the necessary controlling tasks. Such an approach has many advantages: If the students already have some competency with computers they can build upon this knowledge and will deal with the new subjects (i.e. robotics) more easily. Using existing resources (the microcomputers) reduces the cost of the new equipment necessary. Programming as a subject per se is not seen as a main objective for an educational system because of the following reasons: Not many students will have to program in their professional career and therefore the practical values of teaching programming may not be to high. Robotics on the other hand may be an activity where many of out students will be involved in the future and therefore having some basic knowledge about how these devices are functioning may be a major goal of an educational system. If this goal has the side effect of teaching some basic programming concepts also then this kind of activity is of multiple value and that can only be seen as being of an advantage with respect to education. Using robotics kits together with microcomputers also broadens the range of projects available to train general problem solving strategies. "Teaching thinking" in many educational strategies almost always was tied to pure abstract thinking without easy to see analogies in the physical reality. Now these devices offer the opportunity to connect abstract thinking (and computers as a tool for this aspect) with physical reality (and robotics devices as tools for that). In that way out students also may see the transformation processes necessary to translate "real-world" problems into abstract problems which can be dealt with by logic and then retranslating any solutions strategies into "real-world"-solutions.

All these considerations show that implementing robotics in our educational systems is not a problem of technology primarily. We have to analyze our educational needs and the frame of reference given by our respective educational institutions and the ultimate goals of the educational systems to see which kind of approach is the best one under the given boundary conditions.

A COMPUTER SOFTWARE FOR CURRICULUM DESIGN

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ABSTRACT

This study presents a computer software to use more efficiently the Bloom's taxonomy of educational objetives for curriculum design purposes. A sequence of software production following the design, development, and evaluation stages were used to construct a software that supports the planning of the instructional curriculum. The cognitive and affective domains are implemented in a computer program by using MacPascal and taking into consideration instructional variables such as sequence of the instruction(from concrete to abstract or vice versa), learning pace (slow, normal, and rapid), academic achievement (low, normal, and high)of the targeted audience, and the categories and subcategories of cognitive and affective development. The software was constructed based on a mathematical model that describes the dinamic role of each of these educational variables and their possible instructional interrelations and interactions to design a curriculum more efficiently.

The software simulates in part a curriculum design specialist that advices and helps teachers to design their curricula. The results of this study are briefly discussed in terms of the potential of using this modern instructional tool to construct software that helps and supports preservice and inservice teachers in the design of their instructional curricula by using more efficiently instructional strategies and models such as the well known taxonomy of educational objectives proposed by B. Bloom..

CHILDREN WRITING USING A COMPUTER WORD PROCESSOR

P. A. Ferguson*.

ABSTRACT

Our understanding of how computers will influence the nature of the educative process is in its infancy. Case studies of 12 Oregon, USA, kindergarten students demonstrated that even with a short-term experience with a computer word processor, kindergarten children will use the computer as a tool for writing. The writing behavior of students fits with psychological and psycholinguistic theory. Students' schema for writing are expanding at this age and they are exploring the functions of written language, from typing the alphabet, names, isolated words, to writing complete, meaningful story texts. They are also exploring the inherent rules of spelling, punctuation, and grammar. Observations of students using computers in infant classrooms in Victoria, Australia, also reflect the observed patterns reported in this study.

INTRODUCTION

The research and literature on the development of language and writing in particular revolves around a number of issues. Psycholinguistic theory posits that from an early age children are natural language and writing learners who know that language and written language have meaning which can be communicated. Children have natural problem solving abilities and strategies which they use in "making sense of the world" (ref 1, p.1). These problem solving strategies support mental structures called "Schema" which hold meaningful experiences relative to one another and the child's world. Play and repetitive actions are purposeful and help children test and consolidate understandings of emerging theories about knowledge and language held in their schema.

Current brain research fits well with psycholinguistic theories. Different areas of the brain deal with different aspects of knowledge and action. Wernicke's area and Broca's area deal with word recognition and grammar respectively. The arcuate fasciculus links the words in Wernicke's area to the grammar in Broca's area. In linking the two areas, the arcuate fasciculus travels through the motor areas of the brain which control the mechanics of speech, the lips and the tongue. These are in turn in close proximity to the motor areas controlling the fingers and thumb, the parts of the brain controlling writing and typing. Practice strengthens brain development, without it the neural tissues degenerate (ref 2).

Some school practices seem to be in conflict with modern theories. Schools tend to focus on teaching the component skills of writing, correct penmanship, spelling, punctuation, and grammar. But, there is little encouragement or practice of writing per se when students are only expected to write words, fill the gaps, trace over dot to dots, and parse sentences and paragraphs. Researchers all admit to the complexity of learning to write, however they emphasize that one learns to write by writing (ref 3). Many researchers and teachers are adopting an approach to the teaching of writing which encourages students to pre-write, draft, conference with someone else, re-write, edit, and so on in a cyclic process (refs 4, 5, 6) (sometimes called the Writing Process approach). The approach is highly interactive, both within the mind of the writer, and between the writer and a real audience. Schools and teachers often find it difficult to implement this process.

The possible benefits of using computer word processing to enhance the writing process are speculative (refs 3, 4). Few have researched the question empirically at levels lower than about Grade 3. Those who have (ref 7) have shown that students' writing increases in volume and that they use spaces earlier than in normal pencil and paper settings. Computer word processors have many advantages over the pencil and paper ranging from speed of letter formation, easy editing, through to perfect hard paper copies at the end of the process. Furthermore, everything the student does can be stored on disk and used in later modifications. Finally, the students' work is their own. They control what they write, only releasing a hard copy for sharing when they are ready.

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At this stage in our knowledge about the uses of computers, their effects on society, children, and current educational practices, the nature of language and writing acquisition, the nature of the writing process, and the ways in which children explore their world using their own problem solving strategies, it seems necessary to expose young children to computers and word processing to observe and describe the different ways students interact with and solve the puzzle of the computer.

THE STUDY

A group of 12 randomly selected students -- 6 girls and 6 boys -- from an Oregon, public school kindergarten were interviewed about their home background experiences with writing and drawing, print materials, projected media, toys, and computers. Individual students were shown how to use the simple word processing software program Magic Slate. On 5 separate occasions, lasting between 9 and 44 minutes, each student was observed and videotaped using the word processor in the school's computer room.

Interviews, observational, and videotaped data were transcribed, coded, described, and tabulated. Ethnographic and ethological descriptions of students' activities were used to code behavior patterns for tabulation and analysis. Each videotape was viewed at least 5 times using normal speed, slow-motion, stop-frame, and fast forward search modes to facilitate behavior descriptions. The tabulated results for the various categories of behavior were searched to detect patterns of similarities and differences among students.

Students were grouped into 4 major groupings based upon the decisions made after comparing the data on (a) the amount of writing activity across sessions compared with the amount of experimenting, and (b) the quality of the written products of the students. The groups were Group A the Writers, Group B the Tentative Writers, Group C the Tentative Experimenters, and Group D the Experimenters (students' names were anonymized, Group A names begin with A, Group B with B, Group C with C, and Group D with D).

RESULTS

Students' experiences with writing and drawing in the home varied little. Most students liked to draw and write, in that order. Three wrote little or nothing at home, while 4 boys did not do much drawing. Home print experiences of students varied widely. However, two thirds of them had a wide variety of books and magazines they could read or have read to them, only one had few books. Most students were read to regularly by someone in the family, of these 7 were read to more than once a day.

Student familiarity with modern technologies was indicated by the students' use of electronic toys, TV, VCR, and computers. All the boys and most of the girls had electronic toys, only 2 girls seemed inexperienced with electronic technologies. All except 3 students were able to operate their family's electronic equipment. Only 4 families owned a computer. One girl used her Apple //c to write stories and letters to relatives and friends. A boy was proficient on the Macintosh, using it as a tool for drawing and writing. The second girl used the software program PrintShop to make pictures. The other boy was not allowed to use his family's Apple /// computer; of the 12, he was the most tentative in using the computer.

The students exhibited a range in academic ability, from two reading at above Grade 1 level, through three reading at a beginning Grade 1 level, three at the kindergarten level, two were firm on the letter sounds and blends, one firm on the letter sounds, and one who was weak on the letter sounds.

Only 2 of the students (boys) were apparently anxious about the study in the initial sessions. This assessment was based on non-verbal cues, one was the shyest in the class, and the other was hyperactive. All except 3 worked confidently on the computer by the second or third session. The 3 least confident were boys and each boy required the assistance of the Language Experience Approach to writing. By the end of the study 7 students required little or no assistance with the computer or with producing copy. Of the rest, 3 required LEA assistance, and 2 requested assistance with the computer and writing mechanics. All students required assistance with spelling at some time during the study, however 5 quickly adapted to using invented spelling (although 2 needed help with difficult words such as California). Only 25% of student talk during the writing stages was exclusively about the operation of the computer, the keyboard, and the printer, 55% was about the story and/or mechanics of writing. The remaining 20% of student talk was mixed talk about aspects of the computer and writing.

Group A students confidently wrote using the computer as a tool in all sessions, while 2 Group C students also confidently used the computer as a tool for writing stories in 4 out of the 5 sessions. The 2 Group B students and 1 Group C student used the computer as a tool for writing in most sessions, but they were less confident than the 5 above, requiring more assistance. In other words two thirds of the 12 students used the computer as a tool for writing most of the time. The two Group D students used the computer for their own experimental purposes most of the time. Group C had 2 students who used the computer for writing text, for writing names and words, for writing the alphabet and numbers, as well as using it for their own experimental purposes. Thus, less than 20% of the students used the computer consistently as an experimental tool.

Students varied in the kinds of writing they chose. At least one imaginative story was attempted by 8 of the students. Autobiographical writing was used at least once by 9 students. Names and isolated words were written by 8 of the students, and 7 wrote the alphabet and numbers. Random strings of symbols resulted when 7 experimented.

DISCUSSION

This study's most important finding is that 25% (3) of the students confidently used the computer word processor exclusively as a tool for writing. Furthermore, 2 other students also confidently used it as a tool for writing most of the time, although they did also explore its capabilities. In addition, another 25% (3) tentatively used the computer as a tool for writing all or most of the time. Thus 67% (8) of the Kindergarten group used the computer as a tool for writing all or most of the time. If a majority of young students see the computer as a tool for writing, the implications for educators are powerful. The traditional rhetoric of the writing curriculum needs to be examined with a view to accommodating to the changes technology has already wrought in the ways young children can now approach learning how to write. The traditional teaching of writing skills in fragmented elements of penmanship, spelling, punctuation, and grammar, while important, do not cater to the students' emerging sense of the purposes and meaning in written language. Nor does the teaching of isolated skills give students the practice they require to write meaningful continuous texts.

This study demonstrated that students will respond to urging to experiment with invented spelling of those words they want to use. Some showed initiative in exploring the word charts on the walls in the room to find the word they wanted to use in their text if they could not spell it. Others sounded out words phonetically, while one already demonstrated she had a strong grasp on some of the rules of spelling by the systemmatic mistakes she made. The task of spelling should be made more meaningful to learners by surrounding them with print that they have free access to, such as lists of words the students want to use on the walls where they can be seen. As new words are required these too can be added to the growing lists.

This study also confirms what others have already said about children doing those things they see significant others in their lives doing (ref 8). Three saw their parents writing on the computer, so they wrote on the computer. One imitated his father using the graphics programs on the computer. Two saw mother or sisters touch typing on a keyboard, so they used the computer keyboard for touch typing. Because the teacher can be a significant other, students should see their teachers writing on a computer (and with pens). The teacher should not simply be a technical expert who corrects errors.

Students wrote personally meaningful stories in a variety of genre, showing a grasp of appropriate story structure. Three of the girls wrote stories at or above the normal level of sophistication and length expected in most Grade 1 classrooms. The girls competently used invented spelling, all regularly used the space between words, while one accurately used the period and capitals. These students were coming to grips with the rules of punctuation by exploring written language freely, they were given no direct instructions about these aspects of punctuation. This supports the notion that students who write freely and explore the written language for themselves discover the inherent rules of writing (ref 3). Students should be freed from the constraints of slow penmanship skills by allowing them to use the speed and accuracy of the computer word processor.

CONCLUSION

Despite the short duration of the study, two thirds of the students used the computer as a tool for writing. I suspect that with more extensive exploratory experiences with the computer word processor, all the students would have been writing complete story texts. LEA assistance may help tentative students to make the transition to greater autonomy once they gain confidence, support, and reinforcement for their story writing efforts.

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FORCES AFFECTING THE FUTURE OF EDUCATIONAL PLANNING

B Klier

Abstract:

The importance of effective technology management in achieving educational quality is increasingly recognized. Countries participating in the OECD Programme on Educational Technology identify four sets of factors to which educational technology must respond in coming years. Most important among these are:

a] Educational Demands: in compulsory education the importance of the technological environment in the search for quality; in post compulsory education the breaking down of barriers between vocational and general education, and meeting the needs of a rapidly - changing labor market; catering for adults, especially those who have missed out on earlier educational opportunities;

b] Technological Change: the impact of information technology both on how education systems are organized and managed, and more importantly on how teaching and learning are carried out;

c] Demographic Changes: providing flexibility and adaptability in technology to cope with fluctuating enrollments;

d] Economic Forces: the perennial problem of streching limited resources to meet demands of new technology, maintenance, equipment renewal, etc..

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THE COMPUTERS ARE HERE ... NOW WHAT?

R. H. Reece [*]

ABSTRACT

When plans are formulated for initiating, expanding or upgrading the level of technology in a school's curriculum an important component usually omitted is the inservice training of teachers. New equipment is often based upon technology that is foreign to the teacher assigned to utilize it in the classroom. After being thrust upon teachers and administrators who lack knowledge of fundamental use it is either misused, seldom used or unused. When new technology is introduced to teachers in a non-threatening manner and if teachers feel they have had a roll in its selection, both teacher use and integration into the curriculum became more frequent and more productive in a more timely manner.

INTRODUCTION

The focus of many schools as they contemplate embracing new technology usually centers on securing adequate funding to meet hardware needs that are established by an administrator or designee. Once the purchase orders are signed, preparations to the physical plant usually follow. When the equipment arrives, it is placed in the classroom and the technological transition is considered to be complete.

What happens next? After computers are purchased, many end up in virtual isolation for use only by certain areas of the curriculum. Some are placed in out-of-the-way corners of classrooms. If these are used at all, it often is to function as little more than high tech baby-sitters for students who complete assignments early. Others remain safe and sound, locked up in closets and untouched.

Why does this happen? Adequate preparation of teachers is a seldom occurrence. Teachers can and should be introduced to the new technology in a non-threatening manner. They need to be shown how these new tools can increase their personal level of productivity. They need to see how the computer can be used to meet established

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objectives in their specific curriculum area. They need input during the selection process and they need to have enough access to this new technology prior to implementation that they will feel comfortable with its use.

SETTING

This study took place at a high school with more than twenty-four hundred students in the fourth largest school district in the United States. The school was selected by the district to be the sight for a model program which will integrate the use of computers and technology as an instructional tool in all areas of the curriculum beginning September 1989. Students will be selected from the entire school district after meeting established criteria.

Prior to the initiation of this program, instructional computer use at the school was limited primarily to selected vocational areas and for remediation with no direct involvement by the regular academic program. Surveys indicated that non-school computer use was limited to a small portion of the faculty.

GOALS

With over two hundred computers on their way, steps needed to be taken to prepare the faculty. Initial goals were established. They were: (1) to help teachers become familiar with use of the computer in a non-threatening environment; (2) to advance the faculty's level of instructional computer awareness; and (3) to involve teachers from all areas of curriculum in selection of hardware and software.

METHODS

To facilitate introduction of computers to teachers in a comfortable environment, twenty portable computers were purchased and made available for teachers to check out and take home. Before checking out computers, teachers were introduced to operation of hardware and word processing software on a one-on-one basis by the project manager or by a colleague who had previously checked one out. When additional assistance was desired, appointments were made for individual instruction. Teachers were encouraged to create test, handouts, and lesson plans. Printers were available in school and constructive criticism of output was provided upon request.

While all teachers had certain perceptions of educational computer use, most had not confronted new technology like CD-ROM, data displays, and interactive video. Presentations were made at faculty meetings and individual department meetings which demonstrated various productivity and curricular uses. Arrangements were made for after school inservice classes and local universities were asked to assist with teacher training.

In order to get current faculty involved in selection of software and hardware, special software preview days were arranged with the help of the district. On these days, substitute time was provided for teachers to visit the district's software preview lab. With the cooperation of the Teacher Education Center and the district, funds were provided for seven teachers representing a variety of curriculum areas to attend the Florida Instructional Computing Conference and for the journalism teacher to attend a statewide conference on desk top publishing. Local computer fairs and conferences were also promoted.

In addition, since renovations of computer classrooms occurred slowly, an area of the media center was set up as a "preview center" for the program. With a variety of equipment displayed, this became a showcase of the technology to be implemented while renovations were being completed. Teachers were encouraged to use the equipment for personal productivity and could make arrangements for class sessions.

CONCLUSION

With the actual opening of the magnet program still in the future, the level of success of the project can not yet be determined. The popularity of the computers available for check out has forced the creation of a waiting list. The majority of software ordered was first previewed by the subject area teachers that will be using it. Hardware purchases also were based upon recommendations of the teachers. The positive attitude toward the technological tools at the teacher's disposal has established a firm foundation for a solid program.

CAN THE MICROCOMPUTER BE USED TO MAXIMIZE THE UNDERACHIEVER'S MOTIVATION TO LEARN?

C. S. Calfee*, P. S. Kowalski+

ABSTRACT

This study addressed two questions: 1) Do underachievers have different attitudes toward learning math in the computer lab versus the classroom? 2) Can the underachiever's performance be promoted by computer instruction designed to support classroom instruction? Fifty-six 5th and 6th grade underachievers completed questionnaires assessing attitudes toward math in the lab and the classroom. During an eight week session half the students interacted with software designed by Scott Foresman to parallel course objectives; half the students worked on software not directly related to course objectives. The underachievers reported higher levels of effort, intrinsic motivation, and task interest in the computer room than the classroom ($p < .05$). Controlling for a Scott Foresman pre-test, post-test scores showed fifth-graders in the experimental group gained in performance while reporting more negative affect than any other group. Implications are present for motivational characteristics of computer assisted instruction and transfer of learning from the computer lab to the classroom.

INTRODUCTION

In the majority of schools today, an enthusiastic introduction of computers has not been accompanied by systematic attempts to maximize the benefits of the computer as a learning tool (ref 1). Promoters frequently give more attention to the number of computers available than to the selection of software or the monitoring of student-computer interaction. As a result, many computer labs have become game rooms or drill sessions with little attention to the appropriateness of the material for individual students. The belief that as long as students are interacting with computers they are learning ignores the distinction between motivation and motivation to learn and the problems associated with generalization and teaching for transfer (ref 2).

Literature on motivation and teaching (ref 3) for transfer suggests that the computer's potential in the schools may be realized by coordinating material provided by the computer with lessons provided in the class. By taking advantage of the computer's ability to present individual instruction, challenge the student in the absence of evaluation, and

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provide opportunities to correct errors without negative consequences, course instruction would be supported in an environment that maximized motivation to learn. Courseware, paralleling material presented in class, would maximize opportunities for students to generalize what they are doing on the computer to what they are doing in class.

This study addressed two related questions regarding motivation of the underachiever with the microcomputer. 1) Do underachievers have different attitudes toward learning in the computer lab and classroom, and 2) Can performance of the underachiever be promoted when computer instruction is designed specifically to support classroom instruction. The study focused on motivation and achievement in math.

METHOD

Subjects. Based on a combination of indices, including CTBS test scores, classroom grades, and teacher ratings, 36 sixth graders and 20 fifth graders (32 male, 20 female) were identified as underachievers and selected to participate in the computer study. Students were randomly assigned to the active or comparison group.

Materials. Self-Perception Questionnaire: The questionnaire was based on an instrument developed by Stipek (ref 4). Twenty-three questions, derived from motivational theories, formed the following subscales: 1) Effort--the degree to which one is working at one's capacity; 2) Intrinsic motivation--degree of enjoyment/pleasure derived from the task; 3) Task interest; 4) Perception of competence; 5) Negative affect--the feeling that one is often nervous, confused; and 6) Utility value--the degree to which one does schoolwork because it is useful. Math material included pre and post-test assessments provided by Scott Foresman to accompany the basal text. Accompanying courseware was designed by the publisher to parallel the text. In class and in the computer lab, fifth graders completed programs on fractions and sixth graders completed programs on decimals. Both grade levels' computer programs provided a tutorial followed by a set of problems. Students correct errors with guided feedback and receive summary feedback at the end of each set. Following satisfactory completion of the problem set another more difficult set is presented.

Procedure. Self-perception questionnaires were completed in students' regular classroom before beginning the study and following completion of the study. In their regular math classes, participants completed pre- and post-test assessments and the questionnaire as it related to doing math in their regular MATH CLASS. In the computer lab, participants completed the questionnaire as it related to doing math in the COMPUTER LAB.

Students participated in an eight week session in the computer lab. During half-hour sessions, comparison group students worked on math courseware not directly related to the math they were currently covering in class; active group students worked on Scott Foresman courseware and monitored their progress through series levels.

RESULTS

A multivariate analysis of variance on underachievers' attitudes toward math in the computer room and in the classroom was significant ($p < .01$). Students' attitudes differed in their self-reported degree of effort, intrinsic motivation, and task interest but not in perceived competence or utility value. An analyses of covariance was conducted to assess whether the type of math courseware influenced students' classroom performance. A 2 X 2 (grade X group) ANCOVA on post-test scores with pre-test used as a covariate resulted in a significant grade by group interaction. A comparison of the means indicated that the fifth grade control group mean was lower than that for any other group. Repeated measures were also conducted on students' attitudes toward math in the computer room before and after the program. A significant interaction (grade X group X time) and specific comparison showed the fifth grade active group reported MORE negative affect following completion of the program than any other group.

DISCUSSION

This study demonstrated that underachievers' intrinsic task interest in math is generally more positive in the computer lab than in the classroom. With more positive attitudes toward learning, students may be more likely to engage in learning tasks. However, the effectiveness of efforts to coordinate the computer and classroom to maximize student achievement remains unclear. While no effects of the program were demonstrated for sixth graders, differences between active and comparison group fifth graders' performance were accompanied by increased negative affect (i.e., confusion, nervousness) for active participants. An explanation of this effect may lie in the courseware selected.

The Scott Foresman courseware satisfied the requirement that it be easily coordinated with class lessons--maximizing opportunities for students to generalize lessons across contexts and improve their classroom performance. The similarity in content, however, may have negated the positive characteristics of computer assisted instruction. That is, the computer lab may have become too similar to the classroom. Student comments in the lab, for example, indicated that large problem sets were frustrating and boring. Students in both 5th and 6th grade active groups asked whether they had to do ALL of the problems.

This school-based study has implications for integrating computers and instruction at the elementary school level. While it is important to attend to principles of learning in courseware selection (e.g., generalization) it is equally critical to attend to principles of motivation (ref 5). Intrinsic task interest is a key characteristic of computer instruction that students find missing in daily coursework. If courseware does not stimulate students' interest, there will be little to distinguish it from the classroom. As a result, students who are not motivated to learn in class will not be motivated to learn in the computer lab. In order to stimulate students' interest in learning BOTH class and computer instruction must work together. Based on principles of learning AND motivation, interesting and meaningful computer and classroom environments, which support rather than duplicate each other, can be designed to promote students' positive perceptions of themselves and to influence motivation and achievement.

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CREATING A COMPUTER ADVENTURE

Nancy Skomars

As a culminating project in our one semester course "Computer Literacy", we require that our students write an interactive story. They must use all of the BASIC they have learned: from text keywords to hi and low-resolution graphics. They are to utilize sub-routines as well as if/then decision making statements. The focus of the assignment is not only on combining all of the BASIC statements into one program but is also on improving writing skills.

Because our course is a graduation requirement and our class size can be up to 40 students per hour, we have over 400 students a semester involved in this project. There are 20 computers in our computer room so the students work with a partner. They also alternate days in the computer lab and lecture rooms. Therefore, as supervising teachers and creative consultants, we have 100 stories being created each semester.

We begin the process in the lecture room with a brainstorming activity. The students are asked to think of movies or TV shows that they would consider mysteries or adventures. From that list, they generate common characteristics that they would want to include in their story. Next, they discuss places an adventure might happen. Branching off from that information, we take one "place" as an example to continue our brainstorming. If, for example, we use a desert island as the starting "place" for an adventure, reasons are given for why the main character is there. From those reasons, one is selected to continue this activity. If our character is on the desert island as a result of a shipwreck, what might that person be carrying? The students are made to realize that the reason for being in the selected place will dictate what is being carried. Added to this information is a list of what dangers or tests of skill the character might face in the course of the journey. Finally, the students brainstorm what suitable rewards might await the character if successful.

From these notes, the partners come up with the following information for their story: Where is the character when the story starts, who is the character supposed to be (explorer, vacationer, pirate?), why is this person in the starting place, what is he/she carrying, list 7 to 10 dangers or tests that might be encountered, and finally what will be the appropriate reward for success.

From this information, an introduction is written and word processed. The word processed version is edited, re-written in BASIC and added to programmed title and author pages. The students then begin to flesh out

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their story by programming in graphics and decisions. They must include at least 2 pictures and 5 decisions. Each decision must either carry on the story, re-route the reader or end in failure. The story must be programmed so that the reward is reachable if all the right choices are made.

An average story will take up from 20 to 40 sectors on a disk. The entire project takes approximately 5-6 weeks with 2-3 days a week spent at the computer. Lecture time is spent partly on re-writing, editing, planning, creating a flowchart of the story and other curriculum matters. At least one lecture session is spent on an explanation of what a flowchart is and why it is important to the programmer. Sheets of construction paper are provided and the partners begin to flowchart their story. This flowchart is updated every week during a lecture session and included with the final printout of the program.

When the stories are finished (or time has run out), they are viewed by the entire class and critiqued. Criteria is established indicating what makes a "good" story and students examine each piece of work for readability, spelling and grammar, high interest, correctness of programming, suitability of graphics and level of challenge in the adventure.

Another session is spent at the computers using Appleworks Data Base to colate information about the finals. Students provide such information as location of adventure, number of graphics, type of reward, gender of authors, major danger faced, and occupation of character. This data is then manipulated to show how a data base can generate comparative information. The students will see, for example, how many of them chose the same location and reward or how many of them chose similar dangers but different rewards.

A final day or two is spent in the lecture room discussing how software is packaged for sale and the importance of these packages to the buyer. The partners are then asked to design a package for their program. They must synthesize the main idea of the story not only into one or two paragraphs but they must illustrate that idea as well. Colored markers and construction paper are provided and the partners are given two days to write their title, authors, main idea and design an illustration. For those less creative students, computer magazines are provided for cutting and pasting pictures. These "packages" are then posted on the bulletin boards of the lab and lecture rooms.

All finished programs are saved to a master disk and used in subsequent classes for demonstration purposes. Some stories have even been used in computer reading labs to reinforce reading and decision making skills.

MANAGING CURRICULUM FROM THE KEYBOARD: SOUTH CAROLINA'S PILOT PROGRAM FOR INSTRUCTIONAL MANAGEMENT AT THE CLASSROOM LEVEL

Gary West*

ABSTRACT

This paper presents an overview of the Instructional Management Component of South Carolina's Classroom Management System, a pilot program to develop teacher-level management tools that will computerize and automate the assessement and diagnosis of student needs, the selection and application of instructional prescriptions, and the recording and reporting of the results of those processes and procedures. The Instructional Management Component is described, with details relating it to the management of curriculum and instruction, where its potential exceeds its record keeping capabilities.

INTRODUCTION

In 1984, the South Carolina State Legislature enacted the Education Improvement Act (EIA) in an effort to change the direction and impact of the public schools in that State. With the implementation of the EIA and its sets of standards, school personnel are made responsible for documenting that standards are met and that remediation is successfully provided in those cases when standards are not met.

Documentation of activities is an essential part of every educator's day. However, research indicates that the number of minutes used for teaching and planning for teaching have decreased as teachers spend more of their time documenting the things they have time to do.

The Classroom Management System (CMS) provides the tools for decreasing teacher paperwork and improving record keeping. More importantly, it provides specific tools for helping teachers manage instruction within the district's curriculum. It promotes the integration of the basic skills curriculum into other content areas and vice versa.

COMPONENTS AND TIMELINES

CMS will contain a gradebook, a test generation and scoring system, and an instructional management system (IMS). Those components will be interrelated in that grades from scanned answer sheets can be automatically recorded in the gradebook, right/wrong responses will be sent to IMS for analysis in determining student needs, and the record keeping for all modules will be linked to provide each teacher with information for planning and delivery of instruction.

The real power of CMS will come from the IMS component. It will link all areas of the State's basic skills program to the local district's curriculum. That curriculum will be correlated to the State's basic

*Classroom Management System Coordinator, Greenwood School District 50, Greenwood, South Carolina 29648 USA skills objectives. Resources, including basal texts and supplemental materials, will be referenced in the process of assessment, diagnosis, prescription, and instruction.

Hardware, including local area networks, will be installed in each school during the 1988-1989 school year. The gradebook will be delivered for use in the 1989-1990 school year, the test generation and scoring system will be delivered in the early Spring, 1990, and the IMS component will be delivered in early summer, 1990. As the software is received, it will be placed in use. The 1990-1991 school year will be the first full pilot for the complete system, including the test item banks developed by the State.

CURRICULUM MANAGEMENT

CMS' capabilities to manage the curriculum and instruction provides much more power and potential for teacher use. That ability, while assisting in the reduction of non-instructional tasks and time, also provides correlation, cross-reference, and integration of the curriculum in ways not possible without the use of computer technology.

The instructional management system component of CMS provides three basic services to teachers in South Carolina's public schools: (1) the assessment and diagnosis of individual student needs, (2) the selection and application of prescriptions to remedy those needs, and (3) the record keeping tasks for documenting mastery and non-mastery of learning objectives.

All of those services are dependent upon a defined curriculum with specified learning objectives that have been structured along a learning continuum. Each objective along that continuum must, then, be classified in a manner that will identify skills and subskills that can be taught and mastered at the appropriate point along that continuum.

Curriculum Definition. The South Carolina Basic Skills Assessment Program (BSAP) identifies learning objectives and lists the subskills required for mastery of those objectives. The skills continuum identifies the grade level, the objectives for that grade level, and the subskills for each of the objectives at that grade level.

At the classroom level, additional assessment must be made with regard to appropriate sub-subskills and content skills that would further define the subskills to be mastered by students. The sub-subskills and the content skills complete the "curriculum learning objectives hierarchy" that must be defined, at the classroom level, for each student.

A pre-defined summary report will list the general objectives and the subskills of each. This report will provide a summary of the district's curriculum, the continuum along which it lies, and the hierarchical structure of the objectives along that continuum. From this report, teachers can understand the overall scope of the instructional program and the impact that their participation has within that scope.

A student detail report will specify the specific learning objectives for each student served by the teacher. Those objectives will be clearly defined and the IMS record keeping process will provide detailed information about mastery of those objectives. Non-mastery will be further detailed in the student report, listing sub-subskills and content skills that are to be addressed to promote mastery.

Assessment and Diagnosis of Student Needs. The assessment of content skill needs, sub-subskill needs, and subskill needs will be accomplished through the use of test item banks developed at the State, district, school, and teacher level.

Two assessment records will be kept for each student. One of those, the Continuous Assessment Record (CAR), will be available to teachers at all times. It will contain continuously updated information regarding achievement for each student. The Permanent Assessment Record (PAR) will be updated at the end of each school year, using the information from the CAR.

From the assessment data, diagnostic reports will be readily available to the teacher. Those reports will include student, class, and group profiles, which can be used in planning instructional activities. Reports can also be printed for parents.

Selection and Application of Prescriptions. When diagnosis of student needs is completed, IMS can provide direction in the selection and application of instructional services to remediate those needs. That direction will come from the instructional prescriptions database, which will be built based on the district's curriculum, the available resources, and the location of the student's needs along the learning skills continuum.

Teachers will have access to several reports from the instructional prescriptions database. Those reports will include student, group, and class prescriptions, based on individual or common needs.

Documentation of Appropriate Instructional Services. In South Carolina, EIA requires the documentation of appropriate services to students who have basic skills needs. That documentation process is extensive and is designed to track student data from assessment and diagnosis to mastery of skills and objectives as measured by the State's testing program. That documentation is a time-consuming task, requiring many hours of teacher and clerical time to complete. IMS will provide the services needed to greatly reduce the manual record keeping and to greatly decrease the non-instructional time used for that record keeping.

Much of the required record keeping will be automatically done through the CAR and PAR facilities in the assessment component. Those records will indicate skill needs and the activities toward remediation of those needs. Other record keeping requirements of EIA will also be automatically addressed.

In addition to the basic record keeping tasks (all of which will be automated to some degree), the IMS module will maintain records regarding the results of the State's testing program and will provide a variety of reports that can be used in interpreting those results and in applying those results in constructive ways to the instructional process.

In the final analysis, the records kept in IMS will document student performance and achievement. Those records will be updated at the end of each school year, leaving a clear record along the learning continuum for the beginning of the next year's instruction. That record keeping process is currently done manually by the teachers in South Carolina.

CAUTIONS AND CONCERNS

Because the IMS component of CMS offers so much power in managing curriculum and instruction, it may be misused in several ways. Those misuses are not an inherent function of IMS itself; they are more a function of the educational process (whether automated or manual). The following cautions relate to possible perceptions that may develop about the purpose of IMS.

A good management system should fit the previously designed curriculum--the curriculum should not be designed to fit the management system.

Proper use of CMS is predicated on the existence of the appropriate curriculum for the individual school district. When that curriculum exists and it is properly designed to offer a skills continuum through which students pass, its components can be coded within the management system so valid data are collected and reported from within that system.

The CMS Requirements Specifications document states: "The Instructional Management component of the CMS is in no way intended to be restricted to usage in a remedial environment." There may be an unnecessary focus on those content areas with regard to the development of test item banks, diagnostic tools, prescriptions, and referencing instructional resources. IMS' management capabilities go well beyond those basic skills areas.

Not only will IMS address the basic skills areas, it can be used to manage the curriculum for all content areas. Additionally, it can be used to correlate and integrate those content areas so teachers can get "double duty" from each instructional activity they provide in the classroom.

CONCLUSION

CMS includes three major software components: (1) the instructional management system, (2) the test generation and scoring system, and (3) the electronic gradebook system. Each of those is coordinated with Osiris, the State's school management system. The CMS focus is a sophisticated approach to solving complex educational problems--problems for which there are no simple or short-term solutions.

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HIGH-TECH EDUCATION Vs LOW-TOUCH SCHOOLS
Why Information Age Education is Impossible for Industrial-Age Schools

F Vetter

ABSTRACT

The thesis of the paper is that contemporary schools have not failed, they have done everything they were designed to do. What that is, however, is largely irrelevant, both in approach and content, to what is required in the *information society*.

Industrial society used schools as a means of *socializing a population to machine society*, of developing a mass population of *workers with the minimal literacy skills to* meet the society's economic demands. That society demanded that most people think and act uniformly, reliably and predictably--able to tolerate long periods of boredom doing low-level activities that were, in themselves, meaningless.

By contrast, information society requires high levels of discretionary, higher-order thinking activities, complex problem solving capabilities and has equipped the population through years of media training with the frenetic need to do these things in order to be successful as a worker, as a consumer and, in fact, in order to be *satisfied.*

The paper explores the *shift from mass to individualized education*, pausing to reflect on the relationship between how one is taught and the kinds of orientation towards life, productivity and fulfillment that stem from instructional approaches.

Central to the paper is an re-examination of the computer in education. It takes a novel view of the way in which the computer is perceived emotionally, phenomenologically and epistomologically by children, their parents and their teachers. At issue is a fundamental, watershed break, conjured by information society, in what constitutes reality itself. The computer is not a thing, it is an environment through which the world may be filtered, perhaps even intelligently, into the perceptions of the student. Moreover, the student may now be able to manipulate not only his or her own perception of the world, but the reality that persists within the environment that the computer conceives.

Finally the paper looks at the future focusing on two of the roads that may be taken with computer-based learning. What is confronted is the opportunity for far greater cooperation and humane development as well as the liklihood of a far less attractive set of conditions.

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INTERACTIVE AUDIO TELECONFERENCING:ATTRIBUTES OF SUCCESSFUL INSTRUCTORS

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ABSTRACT

Through a review of research and general publications about interactive audio teleconferencing (IAT) a listing of instructor attributes was completed. This list was then developed into a survey for rating of each item.

Surveys were sent to all teleconference professionals as listed in the 1986 CIP Teleconferencing Directory, 9th Edition. This sample included professionals in secondary and higher education, and the public and private business sectors. Initial and follow-up mailings of the survey (N=370) were accomplished during the fall of 1986. The total number of completed surveys from both mailings of the survey was 85. Twenty additional incomplete and duplicate surveys were returned; seven were "refused" or "unclaimed," three returned as inappropriate for audio teleconferencing, five returned stated previous completion of survey, and five returned completed duplicates. The total response rate of 23% is based on 85 completed surveys of 370 sent.

Seven categories of items were devised from the literature review: I) Course planning, II) Instructional leadership skills, III) Evaluation of students and course, IV) Technical knowledge, V) Human relations, VI) Institutional support, and VII) Characteristics of the instructor. Demographic items were also included.

The low response rate precluded any detailed descriptions or comparisons within some items. Although there were no statistically significant differences among groups there were areas of practical importance for persons involved in interactive audio teleconferencing.

Using a rating scale of 1-5 from very unimportant to very important responses indicated practical information about audio teleconferencing. The following items had greater than an 85% response in Important/Very Important

1.	Requires more planning than traditional course	91.4%
2.	Provides printed material ahead of class time	87.2%
3.	Coordinates with on-site technical staff	89.9%
12.	Provides an agenda for class sessions	88.7%
14.	Uses innovative teaching techniques	86.4%
15.	Gains participants attention	95.1%
16.	Maintains participants attention	93.7%
17.	Integrates use of handouts with use of technology	90.1%
21.	Sets pace for session	86.4%
22.	Varies voice intonation during class	85.2%
24.	Uses innovative course materials	86.2%

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25.	Elicits participation of students	93.9%
27.	Takes charge of session	87.6%
28.	Demonstrates credibility as an instructor	95.0%
29.	Generates enthusiasm during session	96.3%
31.	Facilitates group interaction	88.9%
38.	Evaluates appropriateness of course for audio teleconferencing	88.7%
39.	Uses appropriate evaluation procedures for an audio teleconferencing course	86.3%
40.	Provides immediate verbal feedback to students	85.2%
49.	Actively listens during session	93.7%
50.	Motivates participants	90.2%
55.	Commitment of instructional leaders	93.5%
56.	Funding	93.4%
58.	Availability of technology	90.9%
59.	Staff support	92.0%
60.	Equipment	90.7%

The following instructor characteristics were rated using a scale of strongly disagree (1) to strongly agree (5). Each item below had an 85% or greater response combining the agree/strongly agree ratings.

63.	Leadership	88.0%
64.	Positive attitude	97.4%
65.	Responsive	94.8%
69.	Confident	92.1%
70.	Innovative	92.1%
71.	Supportive	88.2%
74.	Flexible	96.0%
75.	Adaptable	97.4%
76.	Enthusiastic	97.4%
77.	Energetic	88.1%
78.	Approachable	89.4%
79.	Encouraging	91.8%

Data represent only beginning research in this area. There are attributes of instructors which may be unique to interactive audio teleconferencing and areas common for all instructors.

USE OF NEW INFORMATION TECHNOLOGY TO EXCHANGE PROFESSIONAL GROWTH OF EDUCATIONAL EXECUTIVES

J. Yates

ABSTRACT

Swift and powerful forces of change are operating within the educational environment. Many of these forces are new but beyond the control of educational leadership, for example, demography within the United States. All of the large school systems of the nation are significantly majority minority in terms of pupils enrolled. From this illustration of the force of demography, it is quite easy to conclude that educational leadership in the future must be selected, trained, and their capabilities continuously enhanced in quite new and unique ways.

Significant work has been occurring with regard to conceptualizing the domains essential to future educational leadership. Work has been occurring at The University of Texas at Austin in cooperation with the American Association of School Administrators to develop a comprehensive system of assessment to facilitate the professional growth of educational executives for the future.

[Insert spiral curriculum chart]

In order to support the required personal and professional development of executive leaders as they face the range of new and emerging forces of the future, efforts have been underway to develop a system by which each administrator would be assessed in the five domains with each domain containing tasks, sub-tasks, competencies, and skills. A profile resultant of this assessment is to be constructed which suggests a "prescription" for professional growth detailing the specific resources and/or activities that the administrator can utilize for professional growth in each domain.

In order to fully utilize the opportunity for professional growth resulting from these procedures, it is envisioned that a computer-based management system must be developed. This management system would include not only the administration, scoring, and aggregation of assessment data across these domains, but it is conceptualized that with appropriate expert systems imposed upon these data and with an appropriate continuously updated information resource bank of activities and resources for professional enrollment, the "isolated" chief executive officer and key school executives could on demand through mostly self-assessment selection procedures, engage in significant growth activities.

The complexity of this challenge is obvious. However, given the difficult environment of today and the more complex environment of the future, mechanisms must be developed to enhance the professional knowledge and skills of educational executives in order for them to cope successfully with the emerging futures of the educational environment.

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SCHOOL MANAGEMENT BY THE PRINCIPAL FOR IMPLEMENTATION OF COMPUTER USE ACROSS THE CURRICULUM

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ABSTRACT

A pilot project in the North York Board of Education (Ontario, Canada) has placed a high ratio of computers to students in three small schools. In the crucial role of "change agents", the three principals have been engaged as:

- planners and managers of computer use
- facilitators of strategies for fully-integrated classroom computer activity
- developers of indicators of successful implementation
- mentors/coaches for the teachers.

In the pilot project proposal, the first-year implementation will deal with writing across the curriculum using the computer as a tool. The second year will introduce other tool software across the curriculum. The third year will strive for transparent implementation of information technology.

As this project began in September 1988, this paper begins with some background on the evolution of planning strategies within the Board, looks at the local situation and details the early stages of the principals' roles.

ORIENTATION AND DEFINITIONS

The North York Board of Education has approximately 59 000 students attending its 100 elementary/middle schools, 13 junior high schools, and 23 secondary schools. There are almost 4 000 teachers in the Board.

A *Family of Schools* is an organizational grouping of one secondary school and its feeder schools (elementary, middle and/or junior high). Generally, two Families of Schools are administered by an individual *Assistant Superintendent.*

A *Program Leader* is a support staff member assigned to a Family of Schools to provide program-related assistance to principals and teachers.

BACKGROUND

When microcomputers were placed in North York classrooms in the early 1980's, central funds were spent by central staff to provide limited resources to selected locations across the Board. Until 1985, each school was invited annually to submit a rationalized proposal for new hardware. Under this system, some schools increased their complement of computers while others did not. It was often a matter of skillful proposal writing and meeting the deadline!

To encourage local accountability and local decision-making structures, the process was changed in1986. Funds for the purchase of computers and computer-related support materials were distributed to the Assistant Superintendents of the Families of Schools. Within the ten Families of Schools in the Board, each Assistant Superintendent is responsible for the way the funds are spent. Most have convened computer advisory committees to make recommendations for distribution of hardware and software. Typically the advisory committees focus on hardware exclusively: they inventory existing hardware, tally current school populations, then propose maintaining equity by adding one or two computers to each school. This method has gradually increased the amount of equipment in the schools, but in many cases has not resulted in a unified school plan nor the use of the computer as a vital tool in the delivery of curriculum.

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THE G.S. HENRY/VICTORIA PARK SCENARIO

The Families of Schools associated with the Georges S. Henry Academy and Victoria Park Secondary School have a new Assistant Superintendent who has made effective implementation of computers across the curriculum a major family thrust this year.

When Board funds become available to the Family, they are designated not just for hardware, but for software, consumables, furniture, and staff development. All five of these elements are to be processed by the Family Computer Advisory Committee towards a more effective Family plan for computer implementation. At this time, the Software Subcommittee is working on the Software Loan Centre and the Staff Development Subcommittee is working on an upcoming Family-wide Professional Activity Day.

THE PILOT PROJECT

The pilot project is a complex initiative. From the point of view of a hardware allocation model, it will attempt to demonstrate that "immersion implementation" can (under certain conditions) lead to far more effective and successful results than the "give every school one or two computers a year" approach. Because the pilot project money was over and above existing funding, the resources are provided in addition to what the schools would have received otherwise.

The immersion implementation model places three Macintosh Plus computers and one ImageWriter II printer networked through AppleTalk in every classroom from grade one to grade five in three small schools. With every computer came a copy of MacPaint, MacWrite, and HyperCard. There is a disk for every student, as well as printer paper and ribbons. In addition, a Macintosh Plus was placed on the desk of each school principal. A Program Leader is on call to assist principals, teachers, and students with any need from technical set up to sophisticated and innovative applications.

PILOT PROJECT AIMS

The "certain conditions" under which such an infusion of resources, both material and human, can be effectively used centre largely upon the school principal. This is quite evident in the emphasis upon the principal's roles expressed in the project aims as written by the Assistant Superintendent:

FAMILY MODEL:

To set up an exemplary family of schools model(s) for School Management by the Principal for implementation of Computer Use Across the Curriculum.

INDICATORS:

To develop with principals indicators of successful implementation of computer use across the curriculum in the classroom and in the school.

PRINCIPAL ROLES:

To determine how a principal becomes an effective manager and planner for computer use.

To determine how a principal develops and uses a curriculum plan as a basis for determining computer needs and resources.

To determine the role of the principal in facilitating the development of strategies for fully-integrated classroom activities for students.

To determine how a principal becomes an effective mentor/coach in the implementation process described.
To develop with principals the strategies that most effectively move implementation from mechanical to in-depth levels of use.

ASSISTANT SUPERINTENDENT ROLE:

To determine the role of the Assistant Superintendent in facilitating the management process.

SUPERVISION FOR GROWTH (S4G)

To use S4G to stimulate and motivate the above objectives.

Immersion implementation infuses schools with the complete package: hardware, software, support materials, and human resources. In exchange it requires from the total staff commitment to develop and operationalize a plan.

THE PRINCIPAL AS PLANNER AND MANAGER OF COMPUTER USE

The principals were asked by the Assistant Superintendent to make a committment to the project as written. Once they did, they met as a group to define their own aims. The discussion focussed initially on the importance of planning:

PROJECT PLANNING:

Develop with staff an implementation plan for the project.

- develop an *awareness* of information technology
- develop an *understanding* of the incorporation of technology into the educational system/school and anticipate the changes that will result
- *promote the use* of technology among students, staff and the community
- develop and manage a *Professional Development plan* for staff

School staffs are currently developing their own plans. The plans are based on the practical questions:

- What do we want to do?
- How are we going to do it?
- How will we know whether we have been successful?"

The first question may be answered through the plan itself. The second question may be answered through a consultative network for which the principal assumes initial responsibility. The third question may be answered by monitoring the indicators of success to be developed by the three principals.

THE PRINCIPAL AS FACILITATOR OF FULLY-INTEGRATED CLASSROOM (COMPUTER) ACTIVITY

Before the principal(s) can engage the consultative network (support staff and others) to make the project happen, specific aims needed to be written. This is what they intend to do:

RESOURCES:

Manage resources to meet the needs of the program. (Revisit the Five Year Plan.)

STUDENTS:

Ensure that each student develop skills using computer-based information technology as an instructional, personal, creative tool.

COMMUNITY:

Communicate to the community information about the project.

CLASSROOM ENVIRONMENT

Facilitate the creation of a flexible learning environment that uses computer-based information technology to make learning more active and interactive for each student.

CLASSROOM INTEGRATION

Facilitate the development of an integrated curriculum that takes advantage of computer-based information technology.

PROGRAM PLANNING

Monitor the inclusion of computer-based information technology in program and curriculum outlines where appropriate.

THE PRINCIPAL AS DEVELOPER OF INDICATORS OF SUCCESSFUL IMPLEMENTATION

Following the writing of school plans including aims for teachers and students, developing indicators of successful implementation will be the next phase. It is expected that indicators will consider not only the amount of time spent by students and teachers using the computers but also the level of use.

Before the individual principals can understand level of use (based on the Concerns-Based Adoption Model), they need to have personal experience applying computer technology to their own tasks (both personal and professional). It has been predicted that providing computers and appropriate training and support for the principals will be a most worthwhile allocation of new resources in the context of this project.

THE PRINCIPAL AS MENTOR / COACH FOR TEACHERS

Supervision for Growth (S4G) is a Board innovation that, most simply, makes a distinction between "evaluation" and "supervision" in terms of teacher growth. Teachers seeking promotion or those at risk are evaluated periodically by their administrators. The rest of the teachers (the majority) are encouraged to formalize a collegial partnership of supervision to develop themselves according to their own criteria for growth. There is a process of objective setting (objectives must be approved by the school principal), establishment of a coaching relationship between teachers, opportunities for observation and professional activity, and feedback sessions.

Many teachers have chosen to define their professional growth plan and set their objectives within S4G to address computers in education. This is an ideal opportunity for those at the pilot project schools to become coaches with other teachers on staff involved in this initiative. The principal may also be engaged as a coach.

CONCLUSION

This preliminary report focusses on the role of the principal in implementing an innovation. This project does not stop with the challenge of initializing disks and changing printer ribbons. Because the computer is used as a tool in the delivery of curriculum, the people involved at the school level in this project will soon revisit fundamental concepts of education: student-centred learning, problem-solving and decision-making, taking responsibility for one's own education, and thinking about thinking.

This brief paper is but a beginning of the future report on a project that has far-reaching implications for those people who work and learn at the three small schools, for the entire Board of Education, and for the community of educators at large.

COMPUTER APPLICATIONS FOR ADMINISTRATORS

T. Gray Prewitt*

ABSTRACT

All across the nation school administrators are experiencing a steady increase in the volume of information which must be managed by their offices. While the solution of using technology to ease the burden may be an obvious one, many administrators find that actually selecting equipment and software, not to mention learning how to use it, is not an easy task at all.

The Mississippi State Department of Education, realizing the need for assistance, has come to the aid of its administrators by providing through the Mississippi School Executive Management Institute (SEMI), a training module designed to provide administrators with the basic knowledge needed to begin using computer technology to manage the volume of paperwork and data involved in their jobs.

INTRODUCTION

The School Executive Management Institute was conceived to serve as a means of providing school administrators in the state of Mississippi with the update sessions, training programs, and workshop opportunities that are an essential element in their carrying out the various phases of their job responsibilities. Although the Institute was initially created to ensure that school leadership would have the the necessary administrative and managerial skills development opportunities that would be critical to their executing the many components of the 1982 Education Reform Act, its structure was nonetheless developed to allow enough flexibility for the Institute to be able to address new and emerging issues in the future.

One of the issues of greatest urgency to rise to the forefront presented itself in the area of technology, or more specifically, office automation. That the use of technology would be a viable solution to many of the

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dilemmas facing school administrators was undisputed; however, a catalyst was needed that would spur to action the busy administrators who were still using their tried-and-true paper-and-pencil methods to perform day-to-day administrative tasks. The School Executive Management Institute was just that catalyst.

OUTLINE OF METHODS

SEMI's "Computer Applications for Administrators" module is a five-day workshop with topics focusing on Computer Literacy, Word Processing, Database Management, Spreadsheets, and Planning. Materials for workshop participants include a complete set of software along with a training manual covering the five units of the module; the materials are the administrators' to keep upon completion of the training.

With instruction designed to maximize hands-on experience, the workshops flow smoothly when managed by two trainers -- one to provide instruction; the other to serve as "lab assistant". To meet the needs of administrators in all areas of the state, workshops are offered in various locations and in varying time frames, both during the school year as well as in the summer.

The first day of the module, while focusing on making a participant "computer literate", is designed to make even those administrators who have never touched a computer feel comfortable. Beginning with an explanation of the system components and their hookup, the participant is led through such activities as disk care, printer functions, system boot, an introduction to operating system commands, and running a commercial application. To encourage the administrators to learn to "trouble-shoot", trainers, unknown to participants, have actually disconnected system components and removed paper from printers.

The concept of word processing is presented to participants with activities that are designed to provide an administrator with the insight to use the application to solve specific problems he or she may encounter in the performance of regular duties. Through these exercises all the basic capabilities, as well as a number of advanced features, are introduced. The exercises are presented in such a way that even the non-typing participant is able to maintain the same pace as others.

The database management section is an extremely practical one for the educational environment, as participants take actual student data and create a database from which they will learn the searching, updating, deleting, sorting, and reporting features. Administrators quickly see how use of a database manager can provide them with ready solutions to handling student, faculty/staff, and inventory data.

The instances where a school administrator could benefit from the capabilities provided by use of a spreadsheet are limitless. The practice exercises relating to school budgeting, accounting, and grade reporting are a demonstration in themselves of the ease with which the administrator can handle the mathematics of his or her job and make predictions or projections based on these figures. Administrators learn to set up a spreadsheet with its accompanying graphs to seek viable solutions to "what if" situations.

The final day of the module is devoted to planning. Although many of the participants have similar needs and situations, each is still concerned with "Where do I go from here?". The planning component deals with the selection of hardware and software, pitfalls of which to beware in making a purchase, questions to ask of vendors, and what to look for and where to find training and support.

RESULTS

From the inception of SEMI, the success of the "Computer Applications for Administrators" module has been measured with evaluations which are conducted on a daily basis; these have continued to evidence the fact that the administrators in attendance manifest widespread endorsement of the module.

The following is a tabulation of evaluation data gathered from the modules that were taught from June 1987 through May 1988:

COMPUTER APPLICATIONS MODULE
SESSION EVALUATION SUMMARY

Quality of Information Provided	3.86
Quality of Presentation	3.92
Organization of Session	3.93
Usefulness of Materials	3.85
Accommodations	3.93
Overall Session Rating	3.87

The above figures are averages of ratings that have a possible range of one (1), representing a very low rating, to four (4), representing a very high rating. The consistently high ratings of the "Computer Applications for Administrators" module clearly substantiate the belief that this is one of the many training programs provided by the School Executive Management Institute that is a worthwhile endeavor.

Participants enter SEMI's "Computer Applications for Administrators" workshops filled with anticipation and leave with the knowledge that they have gained new skills which will be valuable in the performance of their jobs.

THROUGH TECHNOLOGY A LEADER CAN EMERGE

Alicia Castro*
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ABSTRACT

Technological advancements essential to the business community are fast becoming part of the everyday life of the educational leader. Improvements in the information flow and their effect on educational leaders in Texas, as well as a look at how communications were carried forth in the past and examples of change brought about by the new technology, are detailed. Attention is devoted to various means of assistance to local school districts provided by the Texas Education Agency through the use of its Public Education Information Management System (PEIMS). The concluding section is a discussion on how effective educational leaders emerge as administrative tasks that consumed insurmountable time commitments and human resources are now accomplished with astounding efficiency. The premise of this paper is in concert with Tichy and Devanna's concept that leadership is something that can be learned by anyone, taught to everyone, denied to no one.

INTRODUCTION

> *We will not be able to just respond to this traumatic change going on about us, we will be able to control it; and furthermore, we just might be able to invent our own future. We might not be able to totally control that future, but we might be able to do more than just prepare ourselves for the future; we actually might just be able to prepare that future for us.*
>
> Bill Cook, Ph.D.
> Cambridge Management Group, Inc., 1988

Before the age of personal computers, cellular phones, voice and electronic mail, facsimile machines and laptop computers for travel, members of the business community conducted their affairs in much the same way as members of the education community do today. Communications depended on the U.S. Postal Service, Ma Bell and the secretary's work schedule.

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Today, postal workers are preempted by fax machines, Federal Express and federal holidays. Deregulation of the telephone company has done more than complicate long distance service and billing. Telecommunications competition has provided creative alternatives, ranging from conference calls and cellular phones to more sophisticated integrated computer programs, all of which enhance the top-to-bottom and bottom-to-top information flow. Secretaries, now referred to as administrative assistants, generally speaking, are better educated and informed regarding the availability of equipment designed to make more efficient and effective use of their time.

CHANGES BROUGHT ABOUT BY THE EMERGING TECHNOLOGY

The emerging technology has changed school leaders' operating procedures. In the past, educational leaders solved problems relating to top-to-bottom and bottom-to-top information flow, student enrollments and assessments, and curriculum revisions and updates through detailed, time-consuming, tedious procedures. Accounting reports were commonly routed through the district's chief accountant to the assistant superintendent in charge of administrative services and then to the state's central education agency. Next, the agency would have to record the information and send whatever reply was necessary back to the assistant superintendent. Today electric mail box capabilities have replaced the traditional "paper trail" of office memoranda.

Student enrollment records used to be maintained in the form of handwritten ledgers recorded in permanent ink by individual teachers. Efforts to ensure accuracy caused many school districts to forbid teachers to alter the document with either erasure or correction fluid. Today a school attendance clerk can compile student absentees and tardies of a specific hour or period by recording information from teacher attendance slips into a personal computer that feeds directly into the school district's central computer system.

Student assessments, including report cards, standardized and referenced test data and other permanent records, are still part of a manila folder. However, today's report card may be in the form of carbonless paper duplicates and may have originated from a computerized grade "book." State mandated achievement test results can be retrieved not only within individual school districts, but will soon be made available to the central agency for statewide comparison.

Necessary changes in curriculum revisions and updates were hindered because they required typing and storage in looseleaf notebooks. Today, teachers in large school districts make use of portable laptop word processors in order to record lesson plans, in addition to loading suggestions for curriculum updates. Recorded lesson plans may include appropriate activities, procedures, methods, and teacher-developed, as well as commercially produced, educational materials. Therefore, the probability of creating a more relevant and workable curriculum is enhanced.

PUBLIC EDUCATION INFORMATION MANAGEMENT SYSTEM

The Texas Education Agency is in the process of implementing the Public Education Information Management System. The system will eventually employ two newly-installed IBM systems, Data Base 2 (DB2) and Query Management Facility. Designed to completely overhaul the manner in which information is exchanged between local school districts and the central education agency, the basic concept of PEIMS is to improve accountability measures for the Texas public school system. Combining the bulk of local school district data collections will streamline reporting, reduce duplication, and produce a standard set of statewide data. Data types include finance, staff, organization, student, dropout, and facilities information.

Future implications for the use of technology in Texas school districts provided by the central education agency through the use of PEIMS are far reaching. Even now districts' receipts of state funds are being handled directly via modem and deposited in their respective banks. Recent revisions of personnel staff information, including references and background checks, that once required insuperable time constraints and costly human energy will be effectively retrieved with ineffable efficiency.

The agency will soon be able to decrease the number of school accreditation and compliance visitations as district compliance becomes clearly evident. Student drop out rates should decline because of a tracking system that has the capacity to interface with education agencies in three surrounding states.

Information designed for use by local districts will be made available to others interested in educational information, including government and legislative offices, colleges and universities and various research organizations. Already, electronic mail has enabled the central agency to retrieve and process this same information instantaneously through its centralized computer system.

Less savory implications for the entire educational structure include the effects of centralization and the resulting decrease of local control. Despite the fact that PEIMS may be viewed by skeptics as approaching "Big Brother," the speed and accuracy afforded allow the educational leader to devote necessary time to constructive instructional development, as opposed to the encumbrances of everyday management chores. In order to function in a competitive world even the heretofore "computer phobic" school administrator will find it impossible to avoid the enabling technology.

CONCLUSION

> *Leadership seems to be the marshaling of skills*
> *possessed by a majority but used by a minority.*
> *But it's something.that can be learned by anyone,*
> *taught to everyone, denied to no one.*
> N. Tichy and M. A. Devanna,
> The Transformational Leaders, 1986

By responding to the new technology, educational leaders are transformed into change agents. These times of emerging technological advancements are times when innovative educational leaders are needed. Bennis and Nanus assert in The Transformational Leaders (1985) that new leaders are those who commit people to action, convert followers into leaders and who may concert leaders into agents of change.

"IF THE COMPUTER CAN REPLACE ME, I MIGHT AS WELL QUIT NOW"

R.C. Jones, G.B. Isherwood

ABSTRACT

How does modern technology impact upon school administrators? This is a case study of one medium sized high school that had a microcomputer land on its doorstep one summer day. The computer was networked to other schools and to the central office - it was to provide for "better" school administration. The case discusses how some staff members were initially blinded by the technological miracle. How others questioned its usefulness.

Both principal and vice-principal are in the process of keeping detailed accounts of how this new management information system has helped and hindered them in their initial year of operation. The purpose of this paper is to detail their findings - to show successes and failures - to show how a modern LANed computer contributes to school leadership.

Initial data indicates that the human and technical sides of education complement each other thereby enhancing school leadership.

The session would be of special interest to school principals who will soon be moving to, or who have recently moved to microcomputers and LANS in their schools to manage administrative matters.

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EDUCATIONAL TECHNOLOGY AT A COMPREHENSIVE UNIVERSITY: ASKING THE TOUGH QUESTIONS

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ABSTRACT

Advances in educational or learning technologies pose dilemmas for individual instructors and students, as well as educational administrators. In response to these dilemmas, a number of tough questions must be asked and answered before the development of a successful strategic plan can be accomplished. The purpose of this paper is to show what questions need to be asked and how one comprehensive institution, Eastern Michigan University, is implementing a process to answer them.

INTRODUCTION

"Educational Technology" is not restricted to hardware, but includes organizational and cultural processes, including customs, books, software, etc., that facilitate ideas and actions. Rapidly emerging developments in expert systems, artificial intelligence and cooperative networks create new mechanisms and environments for decision-making and problem-solving. The new technological systems that augment human intellect have been called the "second wave" of the "information revolution." However, many American institutions of higher education, Eastern Michigan University not excluded, have yet to pass the "buy the hardware/software" stage of the "information revolution."

The question to be addressed in this paper is, "How does a comprehensive university, such as Eastern Michigan University, move from this initial stage of electronic technologies adoption to an integrated system of ideas, procedures and people, as well as devices that facilitate learning which is purposive and controlled (educational or instructional technology)?" After a brief review of the background in the literature surrounding this question, the task force approach being used at Eastern Michigan University will be described.

BACKGROUND

While there have been major advances in technology, especially microelectronics, higher education has not successfully integrated many of these technologies into the instructional process. Furthermore, the societal and individual requirements to improve the quality of instruction continue to expand. In response to these dilemmas, a number of national, as well as local panels have been commissioned to assess the state of education and examine the role of electronic technologies in learning.

These studies have been motivated also by the rapidly expanding expectations of both faculty and students for improved access to information technologies. Drake (ref 1) notes that "More critical than the shift from print to nonprint materials, is the necessary metamorphosis of the library from a supply-oriented to a demand-driven organization." Access to computing resources and related information technologies has become a major factor in the recruitment of both faculty and students to college campuses in the United States.

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The 1984 Study Group on the Conditions of Excellence in American Higher Education (ref 2) found that many existing uses of educational technology have the potential of removing "passion from learning" and "diminishing significant intellectual contact between faculty and students." They propose that programs shift their emphasis from the quantity of machines to the quality of instructional uses of machinery.

The 1986 American Association of State Colleges and Universities' National Commission Report (ref 3) promotes the following goals directly relevant to technology: (1) Develop student understanding of science and technology sufficient for contributions to public decisions; (2) increase access to higher education by distance learning technologies; (3) facilitate equity and quality access for all social groups, including minorities, females and the disabled; (4) support faculty efforts to improve their instruction with the aid of technology.

Ironically, many trends in higher education have undermined the goals and solutions recommended by these national panels. For instance, many colleges have allocated funds for machine acquisitions without distribution of funds for instructional development. Advances in learning technologies pose dilemmas for individual instructors and students, as well as educational administrators. The most obvious predicament is the drain on resources necessary to realize the benefits of new learning technologies. How to optimize the instructional advantage of technologies with the classroom, and the curriculum at large, is another difficult challenge.

Taking a proactive approach to educational technology can be argued from the point of view of the economic system. Sculley (ref 4) speculates that "The key strength of 21st century organizations will not be their size or structure, but their ability to simultaneously unleash and coordinate the relative contributions of many individuals." But one does not have to look at the future to find arguments for addressing learning technologies. Students are now entering a work force that requires skills and sophistication with technology, especially information technology. The broadening need for citizen contributions to technology-oriented public policy decisions demands that workers and other citizens continuously acquire new information and experience the technologies themselves. This problem underlies Roberts' (ref 5) claim that "Universities are struggling under new pressures for relevance in a society increasingly dependent upon technology to meet its goals." Also, this claim is a summary of why Eastern Michigan University has launched its Educational Technology Task Force.

INSTITUTIONAL SETTING

Eastern Michigan University (EMU), located in southeastern Michigan, is a comprehensive university with a current enrollment of over 24,000 students (18,000 undergraduates) and a full-time faculty of 700. EMU shares a history much like many state-supported regional institutions in the United States that began as teacher training schools. It has grown from a student body of approximately 2,000 in the early sixties to one with ten times as many students and four colleges, in addition to the College of Education. Today, its mission still includes educating many of the public school teachers in the State of Michigan and elsewhere, but it also has become known for strong programs in applied technology, human services, business and the liberal arts.

The academic computing environment and its organizational structure are in a period of transition. At the present time, mainframe services (VAX Cluster) are managed by University Computing (Executive Division), centralized microcomputer (MS DOS and Macintosh) services for faculty and students are offered by Learning Resources and Technologies (Academic Affairs Division), and the majority of academic departments purchase and control a variety of personal computers (MS DOS, Apple and Macintosh) for faculty and students. In all, there are approximately 200 public VAX terminals, and it is estimated that over 700 microcomputers are being used for academic-related tasks. The majority of other electronic technologies (video, interactive video) are either administered or coordinated by Learning Resources and Technologies. However, the only instructional development type activity is found in a small faculty development center for the use of computing in instruction.

In September 1988, a new management structure was formed within Academic Affairs in order to be more responsive to the need for electronic technologies within the instructional mission of the University. The Provost now heads a management team made up of the Director of Computing and the Dean of Learning Resources and Technologies. Two immediate actions were taken. One was to form an ongoing faculty advisory committee to the management team, and the other was to form an Educational Technology Task Force (reporting its findings to the Provost by the end of the academic year).

EDUCATIONAL TECHNOLOGY TASK FORCE

The Educational Technology Task Force (ETTF) has a membership of 35 (25 faculty members and 10 administrative staff) who were selected and appointed by the Provost. Under the leadership of the Dean of Learning Resources and Technologies, its overall mission is to evaluate the strategic value of learning or educational technology at EMU. Specifically, this includes delineating issues and plausible scenarios, collecting relevant data, assessing educational impact, and projecting the effects of alternative institutional policies.

For instance, there are three general policy issues to be addressed by the ETTF. They are: (1) What are the primary goals of the institution and how does educational technology contribute or detract from each of these? (2) Does the institution seek to shift more control and responsibility to the student for his or her own learning, including the choice of subject matter and the depth of learning these subjects? (3) Should the institutional goals for the next five years be different than they were for the past five years (and what are the technology support implications?

In order to address these and other more specific policy issues, the ETTF took as its first step the implementation of a university-wide academic departmental survey or existing uses of electronic technologies and subjective opinions on new directions in the adoption of educational technology strategies. The results of this survey and other information are being used by five subgroups (six members each, plus a group leader) which were formed within the ETTF to look at the various policy issues from five different perspectives. The following is a listing of the groups, their general task, and a sample of one of the six or so issues that they are addressing.

CORE CURRICULUM

Revision of the basic studies (core curriculum) requirements will mandate new or special applications of educational technology. For example, computer (or technological) literacy has been proposed as a basic studies requirement. What does this encompass and what does this imply?

TECHNOLOGY-ORIENTED MAJORS

Selected undergraduate and graduate programs depend extensively upon electronic technologies. Among these are teaching programs in computer science, television and applied technologies. For example, how can priorities be established for allocation of resources to such programs?

STUDENT-CENTERED LEARNING

Faculty, undergraduate and graduate students in many programs can excel without heavy use of electronic technologies. Yet all can benefit from the appropriate use of educational technology equipment, software and strategies. For example, what is required to integrate learning technologies into the diverse requirements of different disciplines?

NON-TRADITIONAL LEARNING

New techniques for off-campus delivery of learning have been evolving rapidly. Telecourses, electronic conferencing, satellite systems and related media offer new possibilities for distance learning and other non-traditional learners on campus, in the workplace, home and other remote sites. For example, have electronic technologies emerged which have significant implications for the weekend college, international programs and other outreach programs?

FUNDING AND ORGANIZATION

The task of estimating costs must be tackled head-on. Alternative sources of funding must be considered. Also, the concerns of oversight or management of educational technologies are important. For example, what is the optimal technology-based support system for the instructor in 1994 -- how will it be funded -- who will manage it?

CONCLUSION

If electronic technologies used for information in commerce and life, in general, do not become an integrated part of the learning process at our colleges and universities, then the claim that higher education may not be relevant in the "new society" may be justified. However, institutions like EMU have to stop the escalating speed of the "technological merry-go-round" at some point and do an indepth assessment of what needs to be done regarding this dilemma. EMU's Educational Technology Task Force is an example of one such attempt. It is hoped that positive results of this effort may be reported at the 7th ICTE meeting in Brussels.

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THE USE OF LAPTOP COMPUTERS WITH RELUCTANT WRITERS: A PRELIMINARY REPORT

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ABSTRACT

Within the Seattle School District a group of students have been identified as individuals who need help in their education because though they are intelligent while speaking they seemingly are unable to transfer this knowledge into written form. These students are bright and orally articulate, but have difficulty with the physical and mental processes of writing. In a concerted effort to focus on the problems of these students and devise new ways of enhancing instruction for the purpose of improving their academic achievement, a project was undertaken to teach them how to use the word processor as a writing tool and thus to improve their written communication. The Seattle Writing Project, based in part on a previous project conducted at Carmel High School, Carmel, California, provided a means whereby the students would use laptop computers for the development of written products, use an electronic bulletin board for communication concerning the product with the teacher, and then publish of the final products through the use of desktop publishing techniques. Assessment of the products was done using the traditional writing assessment methods in conjunction with a computer-based spelling, grammar, and style-checker.

INTRODUCTION

For the past several years there has been growing interest in the use of word processing to assist students in gaining writing skills. With the increasing availability of microcomputers and sophisticated word processing programs, many students are gaining access to tools which can be used to assist not only in the initial development of written products, but also in the important tasks related to revision of their documents. There are increasing reports of interest in this use of word processors to enhance the writing process, and in the use of computer-based spelling, grammar, and style-checkers. The advent of the laptop computer has added a new dimension in that the students are now able to develop their written products at any location, from the classroom to the school library to their own homes. In addition, coupling these laptops through modems and telephone lines has provided the opportunity for students to "hand in" their papers from remote locations, and also has allowed their instructors to provide initial evaluation of these papers and return them to the students, again through the use of telecommunications.

An initial effort to use portable computers in the enhancement of student writing was conducted at the Carmel High School, in Carmel, California, the results of which were reported at the Fifth International Conference on Technology and Education. As an extension of the Carmel Project, a project was undertaken in the Seattle Public Schools to explore further the use of computers as tools for enhancing student writing. However, the Seattle Project introduced several new variables permitting a more extensive look at the issue of using word processors in the writing process. In the Seattle project, in addition to the use of laptops with their remote access to an electronic bulletin board and the provision of student-teacher electronic exchange, there was a focus on bright, verbally articulate students who exhibited difficulty with the physical and mental processes of writing. The second new variable in this project was the use of computer-based assessment of student writing through the application of WordMap1, a commercially-available spelling, grammar, style-checker. A third new variable has been introduced through the process of publishing the students' writing through the use of desktop publishing techniques to produce camera-ready copy and printing using professional equipment. Thus, the Seattle Project, while based on the Carmel Project, introduced a number of new and interesting variables.

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DESCRIPTION OF THE PROJECT ACTIVITIES

In order to conduct the laptop writing project, a set of activities was developed and submitted in a formal proposal to the Seattle Public Schools. The first activity was the identification of the project teachers. This was considered a most important activity, for the entire project would rise or fall on the basis of the teachers involved and the degree of support which could be elicited from the teachers. With six teachers from three different schools identified, the second activity began, that of training the teachers in the use of the computer equipment as a tool for writing. A set of workshops was developed in which the teachers were provided with instruction in the use of the Tandy 102 laptop computer and its associated software, the Tandy 1000 Desktop and its software, and the bulletin board system including the use of telecommunications software. The first training session focused on the use of the laptop computer as an elementary word processor, including the production of hardcopy using a dot-matrix printer. The second session continued the focus on the laptop; however, in this session emphasis was placed on some of the more advanced features of the laptop including topics such as cutting and pasting and formatting for printing. In the third session attention was given to linking the laptop with the desktop computer through the use of a null modem. Further, in this third session the teachers were introduced to the use of a more sophisticated word processor, DeskMate *Text*, as it is implemented on the Tandy 1000TL. The fourth, and final, training session was dedicated to the use of the bulletin board, and the procedures to be conducted to provide file transfer via telephones.

The third major activity, following the identification and training of teachers, was the development or procurement of assessment instruments. For purposes of assessing the effects of the project, several types of evaluative instruments were needed. First, with respect to attitudinal changes, questionnaires were developed for use with both the teachers and the students. These instruments were designed to detect attitudes toward the writing process, the use of computers as writing tools, the use of computers in general, and general attitudes toward education. Second, with respect to writing skills, the assessment program called WordMap1 was obtained for use in the project. The purpose of using this evaluative device was to produce objective data concerning changes in the writing skills of students. The changes measured were with respect to spelling, grammar, and style. Further assessments of the writing were conducted by the individual teachers.

The fourth major activity, the most extensive of the project, was the implementation of the system with students. These students had been identified as bright and orally articulate, but having difficulty with the physical and mental processes of writing. In other words, there were students who have the thoughts and can express themselves orally; however, they are unable to write their thoughts on paper, some because of a lack of practice and others, due to an unexplainable motor function. During this activity, the teachers identified those computer-related activities which appeared to be appropriate in teaching writing skills. Teachers were provided consulting services concerning these applications on an as-needed basis. Throughout this phase the teachers provided summaries of such uses and also participated in data collection concerning the attitudes toward writing, word processing, computers, and school. Further, the teachers also sampled student writing and submitted documents on diskette for processing using WordMap1. Results from this fourth phase of the project were as follows: (1) students became more proficient in the use of the word processor as a tool to produce text-oriented documents, (2) data concerning attitude and achievement on the part of the students, and (3) data concerning formative evaluation of the project as it was seen by the associated teachers and administrators.

The final major activity of the project, yet to be completed, is to be devoted to the analysis of the formative and summative data and the developing of a final report. It is expected that the final report will contain information relating to the training provided for the teachers, the training done by the teachers with the students, actual examples of the writing of students, summaries of the data collected regarding attitudes toward writing, word processing, computing, and school activities, and summaries of the writing evaluations conducted both by the participating teachers and through the use of WordMap1. In addition the final report will contain summaries of the data collected concerning teacher attitudes toward the project and any anecdotal records collected by the teachers during the project.

PUBLISHING STUDENT WRITING

Recent efforts in coupling the teaching of writing with the publishing of the resultant student writing have indicated that when students believe their work will be published for others to read, they take on a new interest in the writing and produce documents in which they are able to take pride. As an integral part of the Seattle Writing Project there will be the continual monitoring of student writing for the purposes of selecting from each individual at least one document to be printed in a journal containing student writing. With the recent capabilities of desktop publishing being added to microcomputers, the works produced by the students in this project will be uploaded to a desktop computer with a page layout program, such as PageMaker, for the purpose of producing camera-ready copy and finally a professional-looking publication containing writings by the students involved in this project. It is expected that the teachers will be introduced to the operation of the page layout program and will serve then as editors and publishers of the students' documents. The resulting publication will be included with the final report of the project.

SUMMARY AND CONCLUSION

The Seattle Laptop Writing Project has been designed to encourage that special set of at-risk students who are bight and articulate, but for some reason have real difficulty in producing written documents. By means of a series of workshops the teachers selected to work in this project were introduced to the use of the laptop computer for word processing, the desktop computer for more advanced word processing, and telecommunications hardware and software for the transfer of files between computers. In addition, the teachers were introduced to the use of a bulletin board to serve as a clearinghouse for the students' written products. The teachers used the instructional materials with which they were taught to provide instruction for the students in the use of the computers, word processing software, and telecommunication procedures.

The students then used the laptop computers to produce the written documents which were uploaded to a bulletin board residing on a desktop computer. The teachers accessed these documents on the bulletin board, provided feedback, and returned the document and the feedback to the bulletin board. The students were able to access their documents, with the teacher feedback, make necessary changes, and return the document to the bulletin board for further teacher review.

Throughout the project data were collected concerning the attitudes of students toward writing, word processing, computers, and instruction. In addition, the written products of the students were evaluated by means of a computer-based system for checking spelling, grammar, and style. These same written products were also evaluated by the teachers. Once the students had produced these written documents, they were reviewed by a committee of teachers and students and selection of those to be published was made. The documents selected were then assembled, using a page layout program, and the resulting camera-ready copy was submitted for professional printing and binding. The major outputs of the entire project could then be viewed by reading the final project report and the publication of student writing.

An Examination of the Effect of Computer Instruction on the Social Behaviour of Emotionally Disturbed Children

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ABSTRACT

Rapid advances in the evolution of computer instruction has resulted in promising research results in classroom teaching. However, limited studies have examined the effects of computer gaming and instruction on the social and academic behavior of special education students.

This study will examine the effectiveness of the use of computer gaming and instruction via contingency contracting on the social behavior of emotionally/behaviorally disturbed children. Randomly selected experimental and control groups will be compared then reversed on the following behavior variables:

1. Aggression (fighting, striking others)
2. Language (profanity, sarcasm)
3. Compliance (following instructions and rules)
4. Personal (hygiene, dress and peer relationships)

Subjects (Ss) will be selected from a half-way-house facility (Brewers Porch) designed for the treatment of emotionally/behaviorally disturbed children. Treatment procedures for experimental Ss will consist of a negotiated contract with Ss detailing expected social behavior. Points earned by Ss for appropriate behavior will earn computer gaming and instruction privileges. Experimental Ss behavior will be compared to control subject behavior then experimental and control groups will be switched and again compared.

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PROJECT MICRO: A SUCCESSFUL MODEL FOR TEACHING THINKING SKILLS TO STUDENTS "AT RISK"

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ABSTRACT

Project MiCRO, a four year model project of the Southern Coalition for Educational Equity, has demonstrated ways of effectively using microcomputers to enhance the educational computing and critical thinking skills of seventh and eighth grade students "at risk". Research shows that many students "at risk" do not use microcomputers as frequently as educational advantaged students. There are also serious qualitative differences in the ways these populations use microcomputers. Project MiCRO has demonstrated that these inequities can be corrected. In project schools all teachers are trained to teach students to use microcomputer applications as tools to extend their information base to solve problems and make decisions in their academic subjects. In addition randomly selected students take a microcomputer based critical thinking skills course. Parents are involved in Project MiCRO through outreach and parent-directed, in school microcomputer based activities. Results show that Project MiCRO students have made significant gains in some aspects of critical thinking. Interview and survey data show that students, parents, teachers, and principals believe that Project MiCRO has enhanced instruction.

DISCUSSION

Project MiCRO focuses on students who are "at risk" for educational failure because of socio-economic conditions and race and/or gender discrimination. When Project MiCRO began in 1984, a clear pattern of inequity in microcomputer usage had already developed. Minority and economically disadvantaged students had less access to instructional computing than their white, affluent peers, girls less than boys. Minorities had fewer expert computer teachers available to them and little exposure to higher order uses of microcomputers. The First National Assessment of Computer Competence in reporting baseline data (M E Martinez & N A Mead, 1985-86) on the nation's third, seventh and eleventh graders confirmed ethnic and gender differences favoring white boys. These differences did not diminish as the use of microcomputers grew.

The goals of the project are to develop a model for equitably delivering computer literacy skills to minority and economically disadvantaged youngsters, and teaching critical thinking skills through microcomputer based activities. The experiences and results of four years of model development prove that all children, can and should learn to use microcomputers as tools to enhance achievement which involves problem solving and decision making.

Project MiCRO gave a great deal of attention to site selection. Carefully developed criteria included: a history of parental involvement, an openness to innovation support from the superintendent and the school effectiveness criteria developed by Ronald Edmonds (R Edmonds, Ed. Leadership, 37,1, pp.15-23, 1979). All schools were required to have a large number of students "at risk". Participating districts were asked to pledge resources to project schools including hardware, software, release time for teacher training and a room in the school for a parent program.

Project MiCRO defines computer literacy as the learner's ability to use microcomputers to extend his or her information base to solve problems and make decisions in academic subjects. This definition leads logically to several of the project's practices. For example, all teachers use microcomputer applications. Extensive use of application software also allows teachers to design computer activities and projects that meet the academic needs of the students.

At the project's start, most teachers had no computer experience. Site trainers, averaging three - five training days per month and using demonstrations, observations, mini-workshops and teacher conferences as their primary training techniques, give individualized assistance to teachers in each school's computer laboratory.

Project MiCRO also includes a critical thinking skills course in which randomly selected students participate. The course consists of a prescribed set of thinking skills and processes taught using computer based activities. They include observation, recall, classification, sequencing, inference, deduction, induction, association, distinguishing fact from opinion, detecting bias, judging relevance, solving problems and making decisions. Applications, logic games, simulations and Pascal are used to create activities to teach these skills and processes in a structured way (B K Beyer, Practical Strategies For The Teaching Of Thinking, Allyn and Bacon, Boston, 1987). Some of the courseware used for the critical thinking includes Animate, AppleWorks, Decisions, Decisions, Food, Glorious Food, The King's Rule, Mind Benders, Robot Odyssey and Zoyon Patrol. Teachers and students are also taught to use techniques that foster skillful thinking such as, inquiry, modelling, metacognition, peer teaching, wait time and collaboration (Arthur Costa, Developing Minds, Association For Curriculum And Development, Virginia, 1985, pp 66-68). Students receive three to five hours of hands-on time each week, and further instruction in critical thinking off line.

Parents are encouraged to participate in Project MiCRO. Parent coordinators, provided by the project take a microcomputer on home visits to introduce parents to Project MiCRO. Outreach enables the program to involve more parents than would otherwise occur. Each school has a parent room where parents frequently come to practice computer skills. Parent coordinators periodically schedule workshops for parents on analytical thinking skills, word processing, data base management and spreadsheets. After receiving training, some parents volunteer to work with teachers and students in the computer laboratory.

Project MiCRO developed an extensive evaluation that included both quantitative and qualitative measures. As might be anticipated, prior to the project few students (about 16%) had engaged in computer use, other than an occasional arcade game. Likewise, the only competency most teachers possessed was the ability to turn a computer on. In four years, over 80% of teachers learned to integrate computer activities into instructional objectives.

Students were tested on computer literacy competencies in seven areas including word processing, data base, spreadsheets, locus of control, ethics, computer uses and computer occupations. Comparisons between treatment and matched control schools at two-thirds of the sites showed significant differences ($p<.01$). Of particular note were differences in locus of control, documenting that Project MiCRO students were more likely than non-project children to believe that they could make computers serve their needs.

An assessment of visual problem solving using the software, Super Factory (Sunburst Company) was developed by the project. This instrument was administered to critical thinking students as a pretest and post test. Students made significant gains on the post test ($p<.001$).

Through questionnaire data, almost all students, teachers, parents and principals reported that the project helped students learn academically and motivated them. Critical thinking skills teachers reported that students learned thinking skills better with computers than without.

Both quantitative and qualitative evaluation results show that Project MiCRO has been successful. However, evaluation of educational computing and critical thinking at the middle school level is seriously underdeveloped. Instrumentation is poor. More and better data and collection instruments are needed before definitive conclusions can be drawn about the effectiveness of non-drill computer based learning with students "at risk".

However, Project MiCRO has contributed a great deal to what is known about ways to deliver educational computing and higher order thinking skills. Its most important lesson is most youngsters "at risk" are willing and capable of learning to reason analytically and rigorously if given an opportunity. Educators can give them that opportunity having the goal that no student become an information age have not because of low expectations and institutionalized bias.

Second, in order that all teachers can use microcomputers as an effective teaching tool they need a great deal of staff development, three or four times more than the current amount most U. S. school districts offer. Moreover, the success of Project MiCRO was also due in large part to the fact that teachers received site based training in which they were provided immediate corrective feedback and suggestions for alternative strategies when their plans did not work as anticipated. Training in keyboarding should be provided to both teachers and students. School wide use of tool software that share common commands like Bankstreet Writer and Filer, AppleWorks or PFS speeds mastery of application software.

Third, there is no substitute for experience. The more opportunities teachers have to actually work with microcomputers outside of the classroom setting, the more confident they become in the classroom. To increase motivation make microcomputers available to teachers to use during planning time, non-school hours and vacations. Encourage teachers to computerize paper work.

Fourth, using application software, simulations and logic games in an instructionally effective way requires a great deal of active teaching. Teachers must possess a solid grasp of the subject they are teaching as well as solid pedagogic and classroom management techniques. Teachers cannot simply rely on the hardware and software to do the job for them.

Fifth, the instructional program benefits from having the active involvement of parents. This involvement can take several forms including more discussion in the home between parents and students regarding the student's school experiences, or more school visits by parents.

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COMPUTERS, SOFTWARE AND COOPERATIVE LEARNING: WORKING TOGETHER TO THE BENEFIT OF THE LANGUAGE MINORITY STUDENT

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ABSTRACT

Computer settings have generally been found to promote social and verbal interaction among students. The combination of cooperative learning and computer instruction, moreover, has been found to significantly improve cognitive performance more than working at the computer independently. Recent research, however, has found that English language proficiency (ELP) and type of software used effect the amount, type and quality of talk produced even within cooperatively-based computer settings. Criteria for meaningful communication and cooperation are suggested based on findings and implications of recent research.

INTRODUCTION

The use of small groups is enjoying increasingly widespread acceptance as a means to more effectively engage students in purposeful communication and thereby enhance their educational opportunities. Researchers (ref 1), nevertheless, have expressed concerns that opportunities for second language (L2) development are not necessarily enhanced by simply rearranging students into small groups, even dyads. Within a bilingual setting, for example, both Milk (ref 2) and Neves (ref 3) found that small group work might actually constrain L2 acquisition. This outcome was due in large part to the formal (i.e., teacher-formed) or informal (i.e., student-formed) groupings comprised of matched (as opposed to mixed) language proficiency levels coupled with a laissez-faire methodological approach on the part of the instructors which assumed that L2 acquisition and mixed-ability peer interaction in a bilingual classroom setting would occur naturally.

It appears, then, that for talk to occur between and among speakers of different target language proficiency levels, the small group strategy must be complemented by other supporting strategies. Cooperative learning, generally characterized by students working together in small groups or pairs on a common instructional task or program (ref 4), is currently viewed as a viable supporting strategy by various researchers (refs 5,6,7). Johnson et al. (ref 6) have defined an ideal cooperative learning setting as consisting of: (1) training in interpersonal and small group skills, (2) individual accountability for mastering the assigned material, (3) face-to-face interaction, and (4) positive interdependence. There appears to be little evidence of these elements being applied in toto within a classroom setting comprised of speakers having different target language proficiencies. Face-to-face interaction and positive interdependence, however, have been utilized by L2 researchers investigating opportunities for sustained talk between various combinations of native-speakers and non-native-speakers, primarily within adult ESL classroom settings (ref 8). However, the topics, tasks, subjects, and target language proficiency levels generally present within such settings neither reflect the natural classroom settings of elementary schools, where children with a broad range of target language proficiency levels are responsible for learning various subjects within the same classroom setting, nor the linguistically diverse secondary classroom (ref 9).

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A methodological structure designed to actively engage all students in the learning process, regardless of content area, remains needed if L2 acquisition and concurrent subject matter mastery are to be effectively integrated into the heterogeneous K-12 setting. While the literature in this area is relatively scant, three recent studies have addressed L2 use among peers within full and partial cooperative learning settings at the elementary (grades 5 & 6) and secondary (grade 7) levels.

COOPERATION & EFL OPPORTUNITIES

Bejarano (ref 10) found that English as a Foreign Language (EFL) seventh grade Israeli students exposed to cooperative learning experienced greater improvement in listening comprehension and total achievement test scores than did their peers in traditional whole-class EFL settings. For purposes of generalizability to a wider audience, Bejarano's findings appear more applicable to immersion models of education (ref 11) than to the school contexts of mainly low-income language minority students. The homogeneity, for example, among her subjects in terms of (1) general school achievement and (2) first language (Hebrew) are significantly different from conditions found within U.S. elementary and secondary classrooms where groups of language minority students are expected to successfully interact with native English speaking teachers (ref 12) and peers (refs 2,3).

COMMUNICATION, COOPERATION & COMPUTERS

Although cooperative- and computer-instructional settings elicit social interaction among peers to a degree not present, or possible, in the whole-class setting, the question remains as to the degree to which this interaction is educationally communicative. Edfelt (ref 13) found, for example, that much of the discourse between partners, regardless of their respective English language proficiency levels (ELP), could not be comprehended without considering the presence of the computer as a significant element within the interaction. Students' discourse, then, may appear ungrammatical, incoherent, or disconnected to a teacher due, for example, to the effects of graphics and text. As a result, discourse may be a function of a triadic rather than a dyadic interaction, where grouping results in a side-by-side arrangement (ref 13) rather than in face-to-face interaction, and opportunities for communication are constrained rather than enhanced.

Edfelt (ref 13) convincingly demonstrates the difficulty of completing cooperatively assigned tasks in an equitable manner where partners are at different ELP levels. However, an array of contextual variables need investigating before it can be stated that status-inequity will occur whenever students of different ability are grouped together. In her study, for example, Edfelt used The Oregon Trail, a program which required players to make decisions regarding life-sustaining and life-threatening events occurring throughout their simulated travels. Decisions, however, as the situations themselves, became formulaic upon repeated interactions, detracting from the simulation program's ability to elicit active and natural interaction between ELP-diverse partners.

A similar research design (ref 14) utilizing Bank Street Writer, a classroom-oriented word-processing application, however, appears to have elicited communication of a more natural type between ELP- diverse partners. The least proficient English speaker, for example, produced 57% of his total words in English, spoke more English with the native English speaker than with any of his non-native English speaking partners, and generated more simple sentences with this same partner than with any other speaker. Moreover, dyads as a whole produced 59% of their words in the form of simple and complex sentences, while fragments and isolated subordinate clauses accounted for 39% and 2%, respectively.

The degree of interdependence between dyad members also may contribute to communicativeness. Students who are assigned specific roles for a sustained period of time and then allowed to alternate may derive more communicative benefit than those students who merely exchange turns after each computer entry. DeVillar's (ref 14) study, for example, required that the partner responsible for all keyboard operations enter information only after his counterpart responsible for reading all screen text had finished reading and both had discussed information entry options and agreed to enter a particular text. Each dyad member sustained his role for 10 minutes, after which the members would switch roles. In contrast, students who alternated keyboard and screen responsibilities after each turn, as in Edfelt's (1988) study, neither had the opportunity to establish separate roles nor to engage in a particular task for a sustained period of time. Thus, rather than the expected ABAB turn-taking pattern of dyadic communicative acts, a communicatively-aberrant pattern of ABA'B'ABA'B' appears to have emerged (where A and B' signify the first speaker within the dyad and B and A' signify the second).

Finally, the degree to which students are trained in cooperative learning must also be considered as exerting a degree of influence on the communication between dyad members. A two-day collective training session as Edfelt's (ref 13) or a 15 minute per dyad training session as DeVillar's (ref 14) are unlikely to be effective unless the partners are monitored in order to reinforce cooperative practices and discourage conflictive competitive or egocentric behaviors.

In summary, cooperativeness and communicativeness appear less likely to result when (a) dyad members are unlikely learning partners, (b) project tasks are redundant, relying on fixed formats and formulaic responses, (c) roles are ambiguous, and (d) exposure has been slight to formal cooperative learning principles. Thus, familiarity among students with respect to learning in heterogeneously paired groupings, creative tasks, concrete roles, and formal training and monitoring appear necessary if a meaningful communicative experience, one not significantly burdened by status-inequity, is to result between language-diverse peers within the computer-integrated classroom setting.

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COMPUTER TECHNOLOGY IN AN EXTENDED TIME SUMMER PROGRAM

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ABSTRACT

Realizing the need to address the varying learning styles of today's students, educators in Jackson, Mississippi are ever on the alert for the most creative ways available to meet the learning needs of their students.

This project focuses on how maximizing the use of the district's existing computer technology in a summer program that serves as an extension of the regular school year has proved itself to be yet another avenue leading to measurable achievement outcomes.

INTRODUCTION

Believing that there is a core of basic knowledge that all children are capable of learning, and yet that a variable factor does exist in the children's rate of learning, the educators in the Jackson Public School District provide an extended year summer program for children who need additional instructional time in order to master objectives essential for promotion to the next grade level.

Traditionally, the Extended Time Summer School Program has consisted of instructional delivery by a teacher with no provision for the use of computer technology in the summer school curriculum. The introduction to the computer for students in each of the district's thirty-seven elementary schools (consisting of grades one through six) has occurred during the school year via a small lab of six microcomputers in each school.

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OUTLINE OF STUDY AND METHODS

The summer of 1987 witnessed the blending of the two programs; for the first time the computers were used as vehicles with which to assist in accomplishing the objectives of the Extended Time Summer Program. By moving the computer labs from sites where summer school was not held into the eight sites where summer school was held, it was possible to install a Computer Learning Laboratory with a total of eighteen computers in each of the designated summer school sites.

The purpose of the Learning Lab was to serve as reinforcement for the instruction delivered by the classroom teacher. A resource teacher was hired to manage each Learning Lab. The role of this teacher was one of guiding students as they used computer software to work through lessons in their needed areas of improvement. The identified software had been critically selected because of its high correlation with the district's language arts and mathematics curricula.

A total of 2000 students (approximately 250 students in each of the eight elementary school sites) participated in the project. After a brief orientation to use of the computer, each student subsequently spent a thirty minute period in the Computer Learning Lab three to four days per week, for a total of one and one-half to two hours computer time per week.

Prior to each student's initial visit to the Computer Learning Lab, s/he was pre-tested with a district-prepared test which measured any knowledge gaps the student may have had in the district's basic curriculum at his/her particular grade level. At the conclusion of the six week summer program each student was given a post-test -- again, the same district-prepared test measuring knowledge of the basic curriculum.

RESULTS

That today's children are stimulated by technology came as no surprise to anyone, nor did the fact that "stimulated children" would readily translate into "learning children". In addition, the use of computer software matched to the district's learning objectives provided a way of individualizing student learning, so that children with a wide range of instructional needs easily worked side by side, each beginning at his/her own particular level and progressing at his/her own rate. This made the computer an extremely effective learning resource, as well as a quite powerful teaching tool.

The use of the computer as a learning resource in the summer instructional program brought about unexpected, but gratifying, results. Students who had been labeled as low-functioning anxiously awaited "computer time" as they began to comprehend concepts that they previously had not grasped. As a result of new accomplishments, feelings of triumph and self-worth began to surface.

The project received high marks not only from students, but from parents, teachers, principals, and district administrators alike. Not only was there a verbal message of success from all involved, but written evaluations from teachers and administrators were exceedingly positive and quite supportive of the undertaking. One of the most convincing pieces of evidence of the project's success emerged during the spring of 1988 when district administrators who had initially voiced misgivings regarding the placement of the computers in the extended year program began to appeal to again use the computers in the upcoming summer session.

The pre-test and post-test data collected from implementation of this project evidenced an average gain per student of more than five percentage points. Although use of the computer was found to be effective at all grade levels, a high and consistent correlation was found to exist between grade level of the student and gain in performance. In other words, the greatest gains were found to be at the sixth grade level, while lesser gains were found at the first grade level. There was no formal evidence as to why this occurred; however, the instructional staff suspected that prior computer experience of the older students increased their grasp of the technology early on in the six week summer program, giving them a slight edge over the younger, more inexperienced students. It was felt that had the program been of longer duration, this difference in gains possibly would not have occurred.

The evidence found by evaluation of this project clearly substantiated the fact that students who use the computer with appropriate language arts and mathematics software do show significant outcome gains.

COMPUTERS, A PERSONALIZED TEXTBOOK AND EXTENDED TIME: WRITING SUCCESS FOR LEARNING DISABLED STUDENTS AT FLORIDA A&M UNIVERSITY

S.M. Wooten*, C.L. Wooten^, and R. Campbell+

ABSTRACT

The word processor is used to enhance writing ability and writing for pleasure beginning with college preparatory (CPREP) English and throughout the English composition sequence. Writing at Florida Agricultural and Mechanical University (FAMU) is an opportunity for learning disabled students to express themselves fluently in print. Through the cooperative efforts of the Learning Development and Evaluation Center (LDEC) program and the English department an English program has been designed that includes a textbook, written to the learning disabled students, and extended time to ensure an opportunity for success. The learning disabled students at FAMU engage in more writing revisions with less frustration when using the word processor. The LDEC is a program specially designed to assist learning disabled students to compete in college level studies.

INTRODUCTION

Florida A&M University (FAMU), through the School of General Studies, provides a unique and comprehensive program for students with specific learning disabilities who desire to pursue college level studies. The program is called the Learning Development and Evaluation Center (LDEC). The primary objective of the Center is to offer students with specific learning disabilities, who have the potential to successfully compete in college level studies, accessibility to postsecondary education programs at FAMU. This is accomplished through traditional approaches and technological applications. Through technological advances in the field of education the learning disabled student is able to attain goals that were, heretofore, not possible. In the LDEC students are offered a wide range of instructional programs on computers, as well as, instruction using other assistive devices such as audiovisual readers and the

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Kurzweil Reading Machine (a machine that will speak the written page). Program participants receive writing instruction using a word processor to enhance their writing skills. The uniquely designed writing instruction program, using the word processor, is introduced in college preparatory English and continues throughout the English composition sequence.

Due to the nature of learning disabilities, it became apparent that these students need a textbook for English unlike any that we have found on the market. Consequently, the LDEC Director and an English professor began writing an English composition textbook that has several unique features. Some of these features are: the textbook is written to the student; it is in workbook form in that it has exercises; it is presented in a ring binder so that pages may be added; the students begin the class by writing, they do not become bogged down trying to identify nouns, participles, or adverbs; and, the vocabulary level is also simple and concise.

PROGRAM DESIGN

The LDEC and the English department at FAMU through cooperative efforts have designed an English program specially for learning disabled students to ensure an opportunity for writing success at the college level. The goals of the program were to provide a new avenue for enhancing writing skills for the learning disabled students in the LDEC and to enhance their opportunity for writing for pleasure; with hopes that the students would continue to use the word processor as a tool for writing. The program was designed to be implemented in three phases.

Phase 1. The program begins at the college preparatory level (CPREP). CPREP students are assigned to the developmental program after failing to pass the Test of Standard Written English (TSWE). To exit the program students must pass the TSWE and pass a writing test that meets established departmental standards. CPREP courses are three (3) hours, non-degree credit.

The CPREP course is taught in the LDEC. The class enrollment is kept to a maximum of 15 students. Each student has access to a computer and printer. During this phase of the program the students are provided additional assistance from a graduate assistant during class time and after classes. Duration of CPREP Phase 1 is one semester, unless it is necessary for a student to repeat the course.

Extended time that exceeds three semesters requires a recommendation from the LDEC Director and the Dean of the School of General Studies.

A typical class week works as follows:

Course times are set on Tuesdays and Thursdays to provide students with longer class sessions.

Tuesdays: Group A - works on computers, aided by a graduate assistant.

Group B - lecture, by professor.

Thursdays: Group A - lecture, by professor.

Group B - works on computers, aided by a graduate assistant.

The lecture sessions include exercises or TSWE problems at modular work stations. Instruction is provided on topics that will subsequently be practiced on the computers in the following class meeting.

Phase 2. After the learning disabled student has met the requirements for successfully completing the CPREP phase of the program, he or she is enrolled in English Composition. By this time, the student is familiar with the word processor as a tool for writing.

The class week works in the same manner as Phase 1 and should provide service as a smooth continuation of the English sequence. Even though Phase 2 lasts two semesters, the course is for three (3) degree credit hours. Students receive a grade of "I" at the end of the first semester and receive their earned grade at the end of the second semester.

Phase 3. The learning disabled students may sign-up for Phase 3 after the successful completion of Phase 2. Phase 3 follows the same manner of instruction. However, the regular textbook is used and the time is extended only when additional time is necessary for the completion of the course requirements.

CONCLUSION

Students in the LDEC program have a unique opportunity to enhance their generally poor writing skills. Writing, in most cases, generates negative feelings from the LD students. However, technological advances have indeed changed this fact. The LD students at FAMU have found that writing, using the word processor, can be an enjoyable experience. The English composition course sequence has been specifically designed to meet the individual needs of the students.

The English program was designed to be taught in a time frame consisting of a variable number of semesters. The extended time has allowed the professor to guide the LD students toward becoming good writers at a pace that helps them to realize success.

Writing for LD students at FAMU is an opportunity for them to learn to express themselves fluently in print. This success was for the first time in many cases. These students engage in more revisions with less frustration when using the computer. Students now take the act of writing more seriously because they have been provided the right tools for writing. FAMU now has what most teachers want - students who care about their work.

TASK-FOCUSSED INSERVICE ACTIVITIES

Alistair C. Thomson *

ABSTRACT

Inservice education in the use of computers in education must focus on the uses of the technology in supporting the educational processes which we wish to encourage. This presentation asserts that this can only be done by designing inservice activities around the kinds of educational materials which are worth using in the classroom, and by viewing these materials not only as resources for use in the classroom, but also as an opportunity to enrich the educational philosophies of the teachers.

INTRODUCTION

Computers are compulsive, technology is tantalising, and software is sexy. There is no doubt that many students, especially males (and not only the brightest) are switched on by the presence of machines in the classroom, and by the chance to use them. They are motivated and intrigued, and this doesn't seem to fade much as familiarity grows. There are teachers, also, who get switched on in a similar way. Hands up all of us who have struggled against all odds, at all times of the day and night, to program a computer with an educational idea we have had, spending a total of probably a couple of hundred hours glued to the keyboard as we built up the package of our dreams. And when it comes to designing these packages, there is often much more interest in finding out what we can do with the computers than in trying to decide what needs to happen in the classroom. Thus, we get computer packages which consist of a disc or discs, and a sheet of paper telling us how to load the program. No guidance on how to organise the class, no information of aims and objectives, nothing about off-computer activities (who needs off-computer activities anyway - is this a COMPUTER package or isn't it?).

Naturally, this philosophy is reflected in the kinds of inservice activities offered to, and sometimes demanded by, teachers. Lots of "How to plug your computer together", "How to get a catalogue of the files on the disc", "What to do if the computer is sick all over the carpet", and (heaven help us) "How to program the computer yourself". The result is a cadre of teachers who can successfully bamboozle their colleagues with "Oh, yes, the DOS was corrupted, and anyway, you need Version 4.4, because the earlier version doesn't support EGA" and other such mumbo-jumbo. But when it comes to actually using the computers in the actual classroom with actual kids, you find ten varieties of Hangman and a Mathematics drill program.

The solution is clear; inservice education in the use of computers in education must focus on the uses of the technology in supporting the educational processes which we wish to encourage. This can only be done by designing inservice activities around the kinds of educational materials which are worth using in the classroom, and by viewing these materials not only as resources for use in the classroom, but also as an opportunity to enrich the educational philosophies of the teachers.

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SOFTWARE DEVELOPMENT

There are many conflicting pressures on designers of educational software. It is well established that computers have many applications in education; indeed, there almost seems to be an industry in developing acronyms describing (or not, as the case may be) these uses, such as CAL, CML, CBT, CMI, and others.

There are good, and bad, reasons for many of these acronyms. One good reason is simply that different educational users of computers have different needs. For example, the teachers need materials which help with the teaching of new syllabuses and which enable learning in a way which would otherwise not be possible; the students need resources which support them as individuals and are responsive to their preferred strategies for learning; School Inspectors and Advisors have a desire to improve the teaching abilities of staff, and they see the computer as being able to help in the development of teaching and learning strategies; society needs to develop information technology skills in its young people in order that they can play a part in the modern technological world.

This width of purpose has its effect on software developers, who must be quite clear in their own minds about the purposes their materials are to serve. The best way of developing software involves meetings of a development group comprising individuals each of whom has a particular expertise to contribute. Such a group would be composed of teachers, advisers, lecturers, and computer professionals; they would design the overall specification of the package as a group, and the individual members would then create the component parts of the set of materials, including computer programs, worksheets, notes, practical materials, audio-visual materials, and so on.

This is the model followed by SCET, and our groups have two main purposes in mind when creating packages. Firstly, we wish to develop materials which encourage a variety of teaching and learning styles and activities. It is recognised that computers can strongly influence not just what is learned, but also how it is learned, and this contributes to the learner in ways which go beyond the mere acquisition of knowledge.

There is, however, a tension between what teachers are currently used to doing in the classroom, and their roles when using this type of package. There is a much more "hands off" philosophy required of the teacher when learners are involved in discovery learning, for example, and the teacher needs to think differently about the kinds of support to give to the learner. This is in fact a harder job than "giving the answer", and demands rather more from the teacher.

This is the reason for the second aim in developing the package, which is to enable the package to be a vehicle for inservice activity. It is simply not good enough to deliver a software package to a school and then leave them to get on with it. As has been said, the purposes of a package are varied, and the teacher needs to know how best to use the package if it is to be used successfully.

It is of course acknowledged that a teacher can be very successful in using a package for a purpose for which it was not designed, and which was not envisaged by the designers. A teacher who can do this is clearly not in need of inservice training in how to use computers in education. At the same time, those teachers who cannot yet do this will benefit from the kind of inservice activity which helps them to make more effective use of the materials.

AN EXAMPLE - "THE BAXTER'S APPRENTICE"

The SCET package "Apprentice" was developed for use by Upper Primary school classes, that is, for children in the age range 9-12 years. It deals with the topic of life in 17th Century Scotland, using the scenario of a baker's apprenticeship as the basis for a variety of activities such as number work, development of reading, writing, speaking and listening skills, problem-solving, and practical science, as well as the obvious one of Historical Studies. The package employs a variety of learning and teaching styles, and consists of a collection of related computer programs surrounded by other materials of a variety of types, which support these classroom activities.

The package also includes two short video case studies, showing different examples of good practice in the use of the package in two different schools. The package is therefore used for three distinct purposes: in the classroom, it is used as a teaching resource helping the children to learn; in this use, it is also developing the teacher's skills and understandings about teaching methodology; in an inservice setting, when used with the video case studies, it helps in illustrating some of the potential for computers to assist the education process.

A FUTURIST'S VIEW OF HIGH TECHNOLOGY AND THE TEACHER

Tim Crawford*

ABSTRACT

Three scenarios of teacher need (or lack of need) are described to address the evolving need to optimize the use of technology. An argument is made for electronic 'teacher walk-throughs' for new software, and, for the development of low cost specialized electronic tools. There is a need for research into how artificial intelligence software could aid and perhaps replace the teacher in some aspects of education particularly to take advantage of the mushrooming knowledge of brain development and structure. Such software should accelerate learning for most students and create many more 'teachable moments'.

INTRODUCTION

Current research suggests that there is a poor success rate of effectively inservicing teachers to have them adopt something. Dr. Ken Brumbaugh of the Minnesota Educational Computing Consortium has said in a number of talks that 80 per cent of the classroom teachers are indifferent to the use of computers, and are therefore denying their students the benefits which could accrue by using them. Researchers such as Joyce tend to be pessimistic about bringing any significant change in teacher methodology and practice of current teachers. Perhaps the solution is an 'end run' around the reticent teacher by providing easy-to-use technology requiring little or no instruction.

Such a change in software design would create a greater focus by the teacher on the process used by the students and their output. Teachers may need little or no inservice to have students using some types of software. Whatever inservice needed would be to help the teacher to deal with the interactivity of the student with the task, and with the results. It is with these notions in mind that teacher inservice is examined under the following scenarios:

1. teachers have to teach the software;
2. teachers have to interpret the results of some software;
3. teachers may totally ignore the software and hardware technologies and focus solely on the progress of students.

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TEACHERS MUST LEARN THE SOFTWARE

As long as the use of software needs to be taught, teachers will require training on that software. For example, if computer languages or educational utilities such as word processing have to be taught, teachers have to learn the software, then use pedagogical skills so that students not only learn the software but develop the primary skills using the newly learned software tool. As new versions of the technology become available some teachers scramble to learn the new capabilities, then integrate those features into the curriculum with some useful application. There will likely be an ongoing problem of:

a) getting teachers to take the necessary training;
b) and, keeping them updated.

In addition to traditional forms of inservice teachers will have choices of attending courses or learning the software from guide books (not manuals!) or of using on-screen tutorials, or interactively on line with some tutor, or some combination of audio-video presentations. As an aside, administrators seem not to recognize the time required to learn the features and functions of the new hardware or software, nor the time required to adopt what is learned to curriculum. It is doubtful this will change in the future!

UNDERSTANDING ITS FUNCTION AND INTERPRETING THE RESULTS

More sophisticated equipment and software should result in a shift in the role of the teacher. One could predict that more and more software will be designed such that it does most if not all of its own teaching. (Games in video parlors are a case in point.) The operation of some educational software, for example geography software, will be so obvious the learner will quickly adapt and proceed to use it as a tool to master the objectives of the geography curriculum. The teacher would focus on the processes used by the students and interpret the results.

The teacher would be required to have some background on the software--background which focusses on student activity, not the technical operations. In order to provide this background, teacher training disks should be required for all new software. Such disks should walk the teacher through the material relatively quickly. The teacher should have the option to slow down the walk-through at a specific point and request a step-by-step simulation of what the students are expected to do (or would likely do). The teacher would also be provided with sample results and suggestions on how to help the students interpret the what has occurred.

New educational software should be validated and tested using the pharmaceutical model for testing new drugs. Pilot copies of the software would be tested with students. The developers and experts in the field of education would make observations. During this pilot stage the software itself could activate background tasks to collect data about how the student is using the software. From the observations and data collected the developers could insert teaching tips in the finish product.

TEACHERS ONLY INTERPRET OUTPUT

One could predict a volume of low cost, specific application text-book size computers, widely used by students. One would do word processing, spread sheet work, calculating and data base applications. Another would do graphics and animation, with software combining popular paint software with LOGO and CAD. Another would include a piano style keyboard for music composition. Other 'Papert-land' computers could be produced for any special function, not the least of which might be telecommunication, networking and capturing 'immediate information' sent to earth by satellites.

The inservice of the teacher for such a user-friendly device would no longer be necessary. To use an analogy, the teacher of 150 years ago had to teach students how to sharpen the quill pen and use it effectively. The pen is no longer a classroom issue. Similarly, future software would go beyond Papert's "electronic pencil" and become a 'thought machine' which would create the various 'lands' or environments envisioned by Papert. The teacher and perhaps the learner would be oblivious to the technology. The focal point would be 'what the student is doing or has done', not the medium.

Perhaps sophisticated software of the future will enable the educators to reach the summit of the profession, and, as Dr. Wallace Judd suggests in an unpublished paper, "teachers will teach values and analogies only...they will only need to help the student transfer the acquired knowledge and skill (likely acquired from the computer) into real life situations, and will show the student how to do so, with the ethics and values of a truly human society".

THE COMPUTER AS A DIAGNOSTICIAN

The next generations of hardware and software should enable sophisticated monitoring of the learner, become a surrogate teacher and personal coach, and in some non-intrusive way, 'get inside' the learner's brain and become a diagnostician or psychometrician par excellence.

Fascinating findings in brain research about growth spurts combined with the differences in male and female brain function are creating for the educator some interesting problems. Add to these problems the suggestion by Howard Gardner (1982) that the educational system might be short-changing some of the seven or more "exquisite intellectual semi-autonomous realms" of students. The truly 'personal computer' of to-morrow would be a high powered diagnostician, and personal 'coach/mentor'. The scope and sequence of any curriculum could be matched almost perfectly by such a computer to the 'current potential of the maturing brain'.

Researchers might discover that the use of special software produces new brain functions which have never previously occurred in the human brain. Such research suggested above might result in an acceleration of the acquisition of current curriculum, deletion of certain 'tried and true' curriculum units because they are judged to be out of date and trivial, and the implementation of what might be called new, exotic curriculum. At that time the implication for inservice would be profound!

Teachers might finally approach a modern version of Socrates, leading students who have a good base of knowledge and skills into higher levels of intellectual realms. Teacher training would have to reflect the required skills. Instead of preparing teachers primarily to impart knowledge and develop certain skills in students, the teacher will need different skills to assist students to synthesize and apply to the real world what they have learned, in an ethical humane way.

It must be kept in mind that a wise human can and will continue to 'touch' a student in such a way a machine--even a humanoid machine--will be unable to do. As a case in point, when the breakthrough scientists were asked to what they attributed their remarkable achievements they almost unanimously responded that it was the "intimate association with a great inspiring teacher". One wonders if the 7th or 8th generation of computers and their software could emulate such an intimate association.

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TEACHER EDUCATION AND COMPUTERS BEHIND THE IRON CURTAIN: A CHALLENGE TO THE WESTERN WORLD?

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ABSTRACT

Will the symbolic term "Sputnik" raise another red flag of warning to the educational systems of the Western World? What is happening in educational technology behind the Iron Curtain today that will challenge the technological world profile of tomorrow? The focus of this presentation will address these questions applying data that were compiled from interviews, educational visitations, computer journals and literature reviews gathered in Poland during a 1988 summer fellowship program.

INTRODUCTION

When Sputnik was launched in 1957 members of the Western World, particularly Americans, were shocked by this Soviet achievement. Western societies questioned the quality of their educational systems at all levels including teacher education. Science and mathematics were areas that received the most attention as curriculum committees were created and funding was offered from private and public sources for the purpose of revising educational approaches and providing teachers with more scientific and mathematical training.

A common query perplexing the Western World was: How did the Soviet Union, a member of the Eastern European Block Countries, develop such technologically skilled and knowledgeable scientists? One answer was found in the quality and focus of the educational institutions. With the advent of computers and the potential benefits to enhancing learning and teaching, how is educational technology being used in the Eastern Block Countries today? Will there be another Sputnik crisis challenging the Western World?

Albeit, the technology of Western societies is generally more accessible, more varied due to free enterprise competition and more state-of-the-art than in the Eastern Block Countries. However, a technological interest and fervor exists Behind the Iron Curtain that has influenced major revisions in teacher education requirements.

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Unfortunately, many Western societies have little access to research pertaining to the developmental progress of teacher education and computers Behind the Iron Curtain. For this reason, this paper will present current data collected. Primary source interviews and materials gathered from the Eastern Block Countries International Computers and Education Conference plus other educational sources will be summarized. Conclusions and recommendations will be offered to provide the impetus for a more demanding technological approach towards education in Western Society and, in particular, American teacher education programs.

EDUCATIONAL AND SOCIAL CATALYSTS

Since World War II all levels of education in the Eastern European countries have witnessed periodic reforms. With the advent of Socialism, the equalization of educational opportunities was considered tantamount to governmental policies of social rehabilitation. The influence of industrialization in the post-war era encouraged the introduction of new scientific and technological subjects in schools. (ref 3)

As the years progressed, the need for more highly knowledgeable and skilled educators became apparent. Consequently, teacher education requirements were increased. The once basic teacher training programs (liceum pedagogiczne) were abolished and all educators were mandated to receive graduate qualifications through university studies (master pedagogiki.) (ref 2)

During the 1970s, new socioeconomic policies further influenced the necessity for more educational focus on the scientific-technical revolution. New teachers were required to enroll in more technological courses while experienced teachers updated their skills at Centers for Teacher Improvement where science, technology and computer courses were offered. (ref 1)

In 1987 a document was issued through the Ministry of Teaching and Higher Education (Ministertwo Nauki i Szkolnictwa Wyzszego) which outlined the most recent requirements for teacher education. One of the most obvious reforms was the mandated inclusion of computer courses for generalist and specialist students in education from the primary to the secondary levels. (ref 4)

Other governmental catalysts to develop a more computer literate population were the creation of cultural centers (centrum kulturi) and social computer clubs (klub komputorowy). Both settings are available to children and adults including military personnel.

Although internal governmental decisions and directions have greatly enhanced the growth of technology in the Eastern European countries, the mysterious mores and culture of Western Society, as learned through films and television, have become very powerful external catalysts. Children and adults are attracted to the "futuristic" concepts presented in the media. Western technological advances are emulated as much as possible.

CONCLUSIONS AND RECOMMENDATIONS

Through these research data it seems apparent that educational computerization is becoming a foundation for learning in many Eastern European Schools. Teachers are mandated through centralized policy-making decisions to acquire the necessary skills and knowledge to teach technology to their students at all levels of schooling. (ref 5) Although hardware and software are not as easily accessible or available as in the Western World, children and adults are being strongly encouraged to utilize fully the resources that are supplied by the government.

Western Society should realize that technology is not an exclusive tool, but one which is becoming dominant in many parts of the world. Technology can influence the future of economic, political and social development. Behind the Iron Curtain, many teachers and students are becoming computer literate. To ensure competitive academic standards, Western Society needs to mandate the computer literacy requirement for all teachers and students as well. If not, Western Society will be challenged by the ghost of Sputnik.

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THE PEOPLE'S REPUBLIC OF CHINA: TRENDS AND ISSUES IN COMPUTERS IN EDUCATION

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ABSTRACT

This paper is mainly based on primary sources, but secondary sources i.e. printed materials have been used too. The author has interviewed over thirty experts, faculty members and graduate students from over a dozen of national i.e. "key-point" and provincial higher educational institutions of the People's Republic of China. The paper intends to recall the short history of the computer development in China, to compare the past and present situations, and to emphasize some major problems based on the summary of the views of the individuals being interviewed regarding the use of computers in education.

Great progress has been made in computer use in education over the past ten years in China. Ten years ago, computers were strangers to the most faculty members on most campuses of higher educational institutions, not to say secondary or elementary schools. However, nowadays, most higher educational institutions, if not all, have been making use of computers for at least one or more purposes.

Many national universities--universities under the direct leadership of the State Education Commission--as well as provincial universities and colleges have established computer centers, terminal monitoring control, central processing unit, and computer science programs at undergraduate and graduate levels. Computer Literacy courses have either become required or highly recommended elective courses not only at national universities but also at provincial or regional higher education institutions including some two-year junior colleges. Some computer courses are also offered to secondary and elementary students at some experimental schools.

At Nanjing University, free computer literacy courses like BASIC Language were recommended to all the faculty members six years ago.

At Fudan University in Shanghai, lower division students in Physics are required to take a three-hour BASIC Language course, a three-hour FORTRAN Language course, plus a two-hour computer lab course. The students there use Honey Well computers for practice.

At Beijing University, the new editing and typesetting system with the combination of computer with Chinese

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transcript and laser printer came into being in 1985, which was considered one of the ten greatest scientific and technological achievements of that year. According to some experts, this system is very close in function to the TEX system that came into existence in 1979 in the U.S.

At Shantou University, the computer center is open to all the faculty members and to all students. At the University of Science and Technology of China, all students are required to take at least one computer course--FORTRAN Language, and other computer courses like BASIC Language and PASCAL are strongly recommended to all students.

Before 1984, there were very few computer companies throughout the country, but now, just in Zhong Guan Cun along, where Beijing University, Qinghua University and China's Science Research Institute locate, there are over one hundred computer companies.

In about 1982, the number of IBM personal computers was very limited. CROMECO computer, which is quite similar to Apple computer in the U.S., was very popular on most campuses. Since 1984, IBM computers have become more and more popular. For the past ten years, China has developed and been producing its own computers like TJ 2220 system, NCI-2780 computers, Panda Mini-computer, which is very similar to Apple II computers, Great-Wall computer, which is very similar to IBM personal computers. At present, the most popular computers are IBM compatibles, although some users favor computers like Super from Japan, STM from Canada. Some institutions have started using MACINTOSH computers. The most advanced computer China has ever produced up till now is Milk Way computer, its CPU (central processing unit) frequency is 0.1 billion Hertz.

In terms of computer numbers, it is estimated by many that China is only next to the United States. Considering the fact that it has taken the U.S. about thirty or forty years to develop its computers, while it has taken only about ten years for China to catch up in many areas of computer science, China's speed of developing computers is somewhat amazing. Sun Work Station is considered very advanced computer system even in the U.S. and not many institutions have this new system, but it is also available in some institutions in China now. If the China's GNP and people's living standards are also taken into consideration, such a fast development is indeed fascinating.

There are several major problems in existence regarding the use of computers. Some of them are technical problems, but most of them are managerial ones.

1. Lack of well-trained expertise. The computer operators or programmers in many institutions have not received proper training. For many of them, two or three months shorting training program was all they had in computer science. This has caused great trouble. A few years ago, some institutions spent large sum of money to import computers from foreign countries but no one knew how to use them, so the computers had to be kept in the storehouses for

as long as two or even three years. By the time when people knew how to use them, they were already out-of-dated.

2. Unbalanced development among various institutions. Some well-funded universities have already possessed most advanced computers like Sun-station computer system imported from the United States, and these institutions have also been employing the most advanced computer technology in collecting and analyzing data. At these institutions, most faculty members and students have taken some kind of computer course or know something about computers. While at some two-year junior colleges, many faculty members and students are still computer illiterate.

3. Limited use of computers. Computers are used for instruction, research, administration, engineering, etc. to some extent only. Few university/college libraries have library management system. So, customers have no access to Data-base or ERIC search, not to speak of some other sophisticated activities.

4. Under-developed net-work system. Although this prevents the spread of "computer virus" as it happened in the United States last November, users are unable to exchange information or share data. This phenomenon is largely due to political system: every institution would like to possess everything despite the real necessity. Institutions, by and large, are separated from one another. Such a separation also prevents international academic exchange. Very few institutions have established file-transfer programs. Electric-mail by computer is also something very new to most faculty members. Up to this date, only Qinghua University and few other institutions have connected their computer systems with some other net-work in Europe or in the United States.

5. Learning difficulty. As it is known to all, English and Chinese are entirely different two languages. The application of English computers is therefore greatly hindered. We do have various computers with Chinese transcript like IBM 5550, however, it is no easy job to learn how to use computers with Chinese transcript. Those who have good command of English may learn how to use English computers very quickly, but it takes much longer time and much more energy to master the Chinese spelling. In addition, many Chinese characters have the same pronunciation, once a word is spelt out, several dozen or several hundred Chinese characters appear on the screen, and the user has to pick out the right one, hence the slow speed.

6. Management difficulty. Apart from the computers produced by its own, China has imported thousands upon thousands computers from U.S., Japan, Germany, Belgium, Canada, and many other countries, although IBM and Apple computers are the most common ones. It has brought great difficulty to management as well as to training because there are considerable differences among various computers.

Besides, it is almost impossible to coordinate all these different computer systems with one another.

7. Lack of efficiency and effectiveness. Computers are available on almost every campus, however, not all of them are effectively used. Only about 20% to 30% computers are effectively used. In other words, large number of computers are by no means made full use of. Computers at these institutions are only used by a few people for some very elementary purposes. Some institutions use computers as game-playing machines, some use them merely as typewriters, some only use computers for pay-roll purposes.

8. Financial difficulty. Educational funding is a universal problem. However, it is more serious in China. Needless to say, personal computers of high quality are regarded as a sort of luxury, costing about 20,000 yuan, which is an associate professor's ten years total income. Since computers are so expensive, many administrators are reluctant to use them for training purposes.

There are many other problems like lack of electricity due to electricity shortage, high price of paper, and so forth. All those factors influence the development and the use of computers. In spite of all this, computers are becoming more and more important in education, and more and more popular too.

About fifty years ago, an Italian said, if every Chinese just uses one more inch of cloth for their trousers, this world has to produce thousands upon thousands feet more cloth to meet the need. It is true that China has just started learning about computers and how to use computers. But,one step forward in China means nothing but some progress made by 1/4 of the total population of this world. This means a great deal. Just a few months ago, when he spoke to prospective graduates at UT Austin's December Graduation Program, Dr. Steven Weinberg, Noble Prize-winning physicist from The UT- Austin mentioned that maybe next century "will be the century of China." As a Chinese, I consider it a great challenge. Right now, no one can be sure if next century will still be the century of the U.S., or of China, or of a united Europe. But one thing we can be sure, that is, with our mutual effort, we could make this world a much better place to live and work in. And, computer technology is one of the means that we could employ to achieve our goal.

EFFECTIVE IN-SERVICE COMPUTER TRAINING FOR AMTA FACULTY MEMBERS AND STAFF

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ABSTRACT

Staff development is a vital and continuous requirement to insure the improvement of the quality of education received by students. Effective in-service Computer training is a challenging area, especially in a multidisciplinary environment with heterogenous backgrounds and widespread education with respect to the Computer field. This paper focuses on the Computer training program of the faculty members and staff of the Arab Maritime Transport Academy (AMTA). Problems related to previous experience of teaching formal programming languages are highlighted. Objectives and planning procedures of the program are discussed. Program Implementation is described with emphasis on practical considerations and hurdles overcoming. Evaluation methodology and results for the first phase of the program are also presented together with an overview of future plans.

INTRODUCTION

The Arab Maritime Transport Academy is a specialized educational organization functioning within the context of the Arab League. The Academy receives fresh holders of G.C.E., who are admitted to Basic Studies with the purpose of qualifying them to obtain certificates of competency, according to international standards. Brilliant students are offered the opportunity to pursue their studies up to university level to obtain a Bachelor degree in Maritime Transport, Marine Engineering Technology, or Marine Electronics Technology. Activities are extended to prepare Deck Officers, Marine Engineers, and Radio Officers to sit for higher competancy examinations, which qualify them to hold different specialized positions in the Maritime field, and be promoted to the highest grades on board ships or ashore. Shore-based personnel are offered short courses and graduate diplomas in Management and Economics of Maritime Transport, Marine Insurance, Maritime Law, and Foreign Trade. Intermediate Technical qualifications holders are offered special programs to qualify them to work as seamen, Mechanics, Electricians, Stewards, Cooks and Stevedoring Technicians. In compliance with the demands of sponsoring countries and organizations, varied educational programmes are designed and offered within the Maritime Context. Finally, research and consultation services to the Maritime Sector is provided by the Academy's Research and Consultancy

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Center within the fields of Economy, Administration, Marine Engineering, Nautical Sciences and the Environment.

In order to cover this wide range of courses and specializations, faculty members were accurately recruited in such a way that combines both professional and academic qualifications as follows :

34 Ph.D. holders, 8 of them having a certificate of competancy
42 M.Sc./M.A. holders, 19 of them having a certificate of competancy
25 B.Sc. holders, 19 of them having a certificate of competancy
9 Master Mariners
4 Extra Masters
3 Extra Chief Engineers
1 Radio Officer

PREVIOUS EXPERIENCE

Early trials of in-service Computer training had no significant success as reflected by design of curricula or student assignments. By that time, the emphasis in Computer education was on formal Computer languages and the ability to program in a high level language such as FORTRAN, COBOL, or BASIC (ref 1). Computer courses used to be designed so as to incorporate four main topics namely; history of computers, computer hardware, computer algorithms, and FORTRAN programming. The first three topics were theoretical in nature, and the learner used to take them, impatiently looking forward to exercise the pleasure of computer programming. Many of the audience were disappointed to find themselves lost into DO LOOP's and FORMAT specifications. In some cases, failure to do programming properly led to frustration, loss of confidence, and increase in man-machine barrier.

OBJECTIVES AND PLANNING OF STAFF DEVELOPMENT PROGRAM

A comprehensive plan has been devised by the education sector for AMTA staff and faculty members regarding computer training and other related subjects such as statistics, numerical analysis, higher mathematics and operations research. The ultimate goal of the computer training program was improving the quality of education, using the computer as a tool. Faculty should be familiar with computer hardware, operating system commands, commonly-used software **packages, computer software, and programming techniques**. Lists of faculty qualifications, disciplines and interests were surveyed. The fact that faculty tend to choose topics related to their disciplines when offered a training program was taken into consideration (ref 2). Class schedules and time tables were examined, in order to choose training session times to be most convenient for faculty. Availability of computer hardware both for training sessions and tutoring times was investigated in view of the tight lab schedule and faculty time tables. Selection of class instructors and lab assistants was a serious matter to be considered so as to encourage trainees to accept assistance and ask for help. Grouping strategy took into consideration avoiding bad first experience, elimination of fear of computers (ref 3), and participants attitudes towards the probability of committing mistake in the presence of their colleagues. Motivating Faculty not only to participate, but also to keep attending classes till the end of the course was a matter to be considered in the planning phase.

IMPLEMENTATION CONSIDERATIONS

The establishment of a modern well-equipped computer lab was considered a milestone in implementing the above plan. Motivating faculty to participate was done through :

1. Offering faculty and staff the opportunity to acquire their own personal computers through a 2-year, no interest loan plan. A special budget was allocated to that purpose. First-time users of Personal Computers were also the first to apply for owning a PC.
2. Providing a computer facility to each department.
3. Sending a detailed description of the objectives, contents, and scheduling of training sessions to all faculty members.
4. Offering a certificate of attendance to participants whose attendance exceeds 80%.

The first list of applicants was very encouraging. They were classified into groups according to their disciplines. The maximum group size was 15 participants to facilitate practical work and hands-on experience. The best time period to run the course was found to be 2:00 to 4:00 p.m.

The first phase of the training program included two course modules, 30 hours each and spanned over 15 weeks duration, with each module being offered more than once per week. The first module covered computer hardware, disk operating system commands, and introduction to BASIC programming. The second module focused mainly on the three commonly used software applications; wordprocessing, spreadsheat, and database. Courses were designed to provide more hands-on experience and less chalk-board work. An electronic imaging system with overhead projector helped a lot in demonstrations. Examples, exercises and assignments were carefully selected to deal with typical educational cases. A data base for course files, a spreadsheet to trace students progress from recruitment to graduation, and design of course lessons are typical examples. Tutoring sessions were set at 4:00 to 9:00 p.m. daily with the presence of a lab assistant or instructor to provide advice and consultation. External instructors were recruited for that particular purpose, which helped faculty to save face in asking for help. For those who had large computer projects and were in real need for professional help, computer specialists from within and outside AMTA were assigned to provide the required job on hourly basis.

PROGRAM EVALUATION

Observation of the significant progress in staff computer utilization indicated the degree of success of the staff development program. Faculty started to ask for more computer time to be assigned to their classes. Some class notes and lecture handouts were word-processed by faculty themselves. More faculty were involved in the design and implementation of Computer Software. Examples include the establishment of an examination data bank, analysis of education loads, Computer-Assisted Learning system for maritime English, and computer-based academic advising.

A special questionnaire for program evaluation was designed to measure the cognitive, affective, and behavior information regarding participants responses towards computers before and after taking course. 100% of the trainees agreed about the importance of computers as a teaching tool and showed their will to attend more courses. 75% believed in the necessity of using computers in their classes. 83% indicated increase in their confidence when running software packages. 91% believed that their knowledge about computer hardware and software increased by taking the course, and 15% indicated their involvement in using computers to prepare educational material.

The next phase of the program includes offering more courses in computer graphics, advanced programming and introduction to artificial intelligence.

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A TUTORING SYSTEM USING INTERACTIVE GRAPHICS IN A WIMP ENVIRONMENT

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ABSTRACT

The Tephigram Tutor is used to teach meteorologists how to use a complex diagram. It uses interactive graphics in a WIMP environment with useful teaching options. An authoring system was created for the Tutor using the Unix utility Yacc.

INTRODUCTION

The production of any software for teaching necessitates some difficult decision-making about the tools to be used and how they will influence the final product. The trade-off is usually between production speed and flexibility but in some cases the requirements are such that the author is forced to write virtually everything from scratch by resorting to a programming language as the main production tool.

One of the important outcomes of this work has been a series of tools which will enable future courseware development with especially demanding requirements to be carried out with considerably less effort. These tools are described below. Although they arose from a very specialised project they could have very wide application particularly, but not exclusively, for WIMP-based systems.

BACKGROUND

Many of the objectives of the Tephigram Tutor will also be objectives of other teaching software, eg:

- Learning how to use the computer should not be an obstacle even for novice computer users. Keyboards can be inhibiting and their use must be minimised.
- Context sensitive help must be available. In particular, students should never reach an impasse because they fail to understand some jargon or technical language. This applies just as much to the subject being taught as to the use of computers.
- Error detection should do more than simply identify incorrect answers but should try to identify how students reached those erroneous conclusions and suggest ways of avoiding them.
- Students should be able to re-examine earlier work easily. There should be no reason why the equivalent of turning back a few pages in a book should not be possible when using a computer.
- After an interactive session, students should have some material outcome from their work.
- From the point of view of the courseware author the final system should be expandable and easily modified. No programming should be needed if a question is to be altered or added.

The ease with which these objectives were achieved results mainly from using a WIMP environment and choosing to create a specialist authoring system. What is interesting about this authoring system is that it was developed in an extremely short period of time by techniques which could be applied in any project. The Unix utility, Yacc, was used to produce an interpreter for the authoring language in a period of six person-weeks.

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THE TEACHING SHELL

The shell within which the specialist Tephigram Tutor resides was designed to be usable with any other tutor. The principal utilities are the 'help' system, the 'notepad' and a 'calculator', but it is also possible to re-enter the Tutor as if it were another utility in order to revise an earlier stage. The shell exists as an 'empty' program which has interfaces to the utilities.

The 'help' system contains some features which are unusual. Information on any one topic is stored in files which may contain graphics as well as text. Another feature of the 'help' system is that every word in the text is a 'hot spot'. Whenever the mouse is clicked over a help window its position is recorded and the file is searched to identify the word pointed at. This word is then used as a keyword in another call on the 'help' system. The keyword is used to search a list of keywords which are stored, but not displayed, in each help file. In this way any terms which students find difficult to understand can be clarified immediately and the student may then return to the original help window.

Difficulty over jargon is not restricted to text in help files. If a student fails to understand a question he or she will not be able to answer it. The 'hot spot' technique is therefore extended to the text in questions. When the mouse is clicked over a word in a question the 'help' system is entered to search for the keyword. The event-driven nature of WIMP systems means that the student returns to the question automatically after using the help system.

The 'notepad' facility gives the student the chance to take notes while using the Tutor and either store them in a file for future editing or print them immediately. The student may then produce notes containing any of the material, text or graphics, which appears on the screen at any time.

AUTHORING SYSTEM

The main body of the Tutor is a simple program which calls an interpreter to present questions in a pre-determined order. The interpreter reads files of instructions, in a syntax which has been determined by the author. The example below shows the syntax used in the Tephigram Tutor:

```
% Level 1:3:3  Ex 1:3:2b
variables:
       actP1: 1000,
       actP2: 900,
       actT1: 273,
       actTx: from 261 to 264 by 1,
       actTy: from 265 to 272 by 1,
       actTz: from 274 to 278 by 1,
       accT : 0.3,
       dum1 : drawline (-2, actT1, 0, actP1, actTx, actP2),
       dum2 : drawline (2, actT1, 0, actP1, actTy, 0, actP2),
       dum3 : drawline (2, actT1, 0, actP1, actTz, 0, actP2),
       dum, inT, err
inputs:
       prompt "Three lines with different lapse rates"
       "are shown in this layer from 1000mb to 900mb."
       "Click the right-hand mouse button on the line"
```

```
          "which has a NEGATIVE lapse rate"                        18
          "(an inversion layer) :"                                 19
          for ptonline (dum, dum, dum, dum, dum,                   20
                    inT, dum, dum, dum, dum, err, 1)               21
     responses:                                                    22
          if err is not within 0.1 of 0.0 then do action 3         23
          if inT is within accT of actTx  then do action 1         24
          if inT is within accT of actTy  then do action 2         25
          if inT is within accT of actTz  then do action 0         26
          otherwise do action 4                                    27
     actions:                                                      28
          0: give explanation 0                                    29
          1: give explanation 1   suggest revise 1:3:1             30
          2: give explanation 2   suggest revise 1:3:1             31
          3: give explanation 3   suggest revise 1:3:3             32
          4: give explanation 4   suggest revise 1:3:3             33
     explanations:                                                 34
          0: "Yes, that is correct"                                35
          1: "No - the temperature fall in this layer "            36
             "is "<actT1-actTx>"°C, a positive "                   37
             "lapse rate"                                          38
          2: "No - this layer has a positive lapse rate "          39
             "- the temperature fall is "                          40
             <actT1-actTy>"°C"                                     41
          3: "No - make sure you have clicked the mouse "          42
             "accurately on a line and not too near the "          43
             "point of intersection"                               44
          4: "You shouldn't get this error!"                       45
```

The file has five main sections *variables*, *inputs*, *responses*, *actions* and *explanations*. The effect of the contents of each of these sections is:

variables — All variables required for this question are declared and may be initialised in this section. Variables may be initialised to randomly generated values or using expressions involving constants or previously declared variables. Functions (as in the statements between lines 10 and 12) can produce both initial values and other effects. The visible effect of these three statements is to clear any lines remaining from the previous question in the main graphics window, which always has a background graph present, to draw three lines, and to return one value describing each of the lines. The author may produce any function to be called at this stage so it is straightforward to produce the common functions available in most authoring systems.

inputs — These statements are intended to assign values to variables by getting input from the user in one of a number of ways. All inputs have two parts - a prompt and a procedure which gets the input and assigns it to the appropriate variable(s). The effect of the prompt is to open a window for text, if it is not already open, and to display the text of the prompt. Within the text it is possible to substitute the value of a variable by enclosing the variable name in angle brackets (eg "Enter a value bigger than <actT1>"). The procedure part is written by the author and may involve reading keyboard input but is more likely to involve obtaining some value as a result of graphical interaction in the graphics window. In the Tephigram Tutor procedures are available for acquiring the coordinates of a single point, of a pair of points, or to identify a point on an existing line. After the input stage all variables

	have been assigned and it is possible to save any of these values for use in another question. A function which reads values stored in other questions can be used to initialise any variable.
responses	In this section the values of variables are tested and actions are prescribed as a result of the outcome of the test. Conditions may be expressions which will result in a true or false value and may include the common operators (logical and, logical or, =, #, >, <, >=, <=). Some additional operators provide some tolerance in the drawing accuracy.
actions	This section simply links the result of the tests carried out in the responses section to the explanations produced in the next section.
explanations	This sections prints text in the text window. The text printed is determined by the action number in the previous section. Note that the text may include the contents of variables, expressions or functions.

A procedure in the main program reads the question file, understands the syntax and produces the required actions. The code was written by a program which produces C source code. The program which does this is Yacc, a Unix utility. It is not necessary for the machine on which the teaching program is to be used to run Unix. It is only necessary for a Unix machine to be available to the author at some time. Once Yacc has been used to generate the C source code for the interpreter there is no further need for Unix and the C program can be compiled on any suitable machine.

New questions can be added at any time by creating new question files (so long as they use the same syntax). Only if new facilities or an extension to the syntax are needed does Yacc need to be used again.

Yacc stands for Yet Another Compiler-Compiler. It was originally used to generate compilers from a syntax provided by the user. In the Tephigram Tutor the Yacc input file defines the syntax of the question interpreter. The lexical analyser Lex, another Unix utility, is also required. Further details of Yacc and Lex are available in various Unix texts (eg ref 1).

DISCUSSION

It is likely that educational software in the future will need to be much more sophisticated than a simple authoring system can provide. The example described here shows that specialist authoring systems can be created quickly with appropriate tools. There are also advantages in the ease with which the syntax of the authoring system can be extended. Using these techniques it is possible to start using a simple authoring syntax, perhaps very similar to a commercial system, and to add to it as the need arises. All future versions of the system would remain backward compatible for as long as the author wishes.

The teaching shell described here requires a significant programming effort but it may be used in several different teaching applications and has the added advantage then that students are familiar with the environment and can concentrate on the subject material.

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USE OF EXPERT SYSTEMS IN THE DIAGNOSIS OF LEARNING DISABILITIES

W.P. Hresko, P.L. Schlieve

ABSTRACT

Summary:
The accurate diagnosis of Learning Disabled children is the essential first step for effectively remediating learning disabilities. It is imperative that the selection system neither overclassify nor underclassify children. This expert system is designed to assist school personnel in the classification process through:

- analysis of existing data that may form the basis for an LD classification
- interpretation of the data with respect to federal and state regulations and the professional literature
- specification of appropriate additional testing or observation activities that would make the diagnosis of LD/Not LD more certain.

When complete, the system should help diagnostic professionals validate the LD classification of the children they assess.

The system is implemented with the Personal Consultant Plus expert system software from Texas Instruments, allowing both forward and backward chaining, and both frame-based and rule-based knowledge representation.

Non-Commercial Statement: The project is report of activities conducted under a Texas Advanced Technologies research program. This is currently a non-commercial venture.

Equipment Requirements: A fast MS-DOS machine with 7MB available disk and 4MB RAM connected to an overhead projector will enable us to actually demonstrate the system. Otherwise, we will prepare overheads of screens, etc. and talk through the interactions.

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A COACHING STRATEGY FOR AN ARITHMETIC TEACHING SYSTEM

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ABSTRACT

The Coaching Strategy is the fourth and most recent enchancement to our system PCMATH (AL-Kadurie,1988). The Coaching Strategy has four initial main models; the first is to provide appropriate remediation, the second is to present a correct solution-trace (Re-Teaching), the third is to generate a particular drill and the fourth is to illustrate a pupil's performance (Pupil Profile). We present some ideas which maybe of use in the domain of teaching arithmetic and maybe used by pupils to foster and improve their arithmetic skills. Furthermore, the system can be seen as an aid for the teacher, and even the pupil, to discover the major area of weakness in the pupil's conceptual arithmetic skills. It is designed to be helpful and supportive to teachers. It distinguishes among pupils and indicates which subject the pupil needs to be taught about.

INTRODUCTION

One of the contemporary problems which confronts the educationalist and the specialist in Artificial Intelligence (AI) is teaching mathematics. There are so many problems involved in this, such as how to teach and the best way to diagnose errors, remediate and reteach.

In our earlier paper (AL-Kadurie,1988), we described a system called PCMATH. It is built as a practical computerised diagnostic system which knows about almost all possible systematic arithmetic bugs. It aims to diagnose the pupil's errors and then provide appropriate remediation. We believed that giving appropriate remediation is not sufficient to enable an educationally-oriented package to become self-adaptive. Therefore, we have extended the project to cope with this issue by developing a new strategy called the 'Coaching Strategy'; this strategy represents a substantial part of the project. Hence PCMATH will now incorporate four teaching levels: Exposition, Assistance, Test and Coaching.

Our Coaching Strategy is able to provide the extra guidance and remediation which an under-achieving pupil needs. Also it will not be concerned merely with errors; the idea is to chart the pupil's progress in terms of the numerical concepts and skills that they already possess. Furthermore, the Coaching Strategy as currently implemented produces an overall diagnosis of the pupil's performance and fosters the arithmetic understanding that necessarily underlies their use. It provides an insight for the teacher into the pupil's cognitive processes in carrying out simple arithmetic operations.

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COACHING STRATEGY ARCHITECTURE

Our work is being extended into the domain of coaching strategies. As far as we know, our methodology in this domain is completely novel. The Coaching Strategy model for the PCMATH system consists of four modes:

[1] **Model-based Remediation mode.**

[2] **Model-based Re-teaching mode.**

[3] **Model-based Coaching mode.**

[4] **Pupil Profile mode.**

1. Model-based Remediation mode

In our case, the Model-based Remediation mode points out and labels as incorrect specific error(s) made by the pupil before presenting a correct algorithm for solving the drill. The main idea underlying the PCMATH system is the inclusion of a knowledge base of the possible systematic bugs (AL-Kadurie,1988). Thus, until now, the PCMATH system was developed to diagnose the pupil's error(s) and specifically remediate that error(s).

The philosophy behind the remediation is that it would be beneficial to highlight each error, explain what is wrong and what should have been done. We have take into consideration the fact that the diagnostic process should consider cognitive and affective elements as well as elements concerning learning style. A further clarification is provided by the system to give the exact location of the error using graphics and animation techniques. As far as we know, no similar implementation has been attempted.

2. Model-based Re-teaching mode

The Re-teaching mode is executed after the pupil has been shown the possible causes of error by the Remediation mode. In fact, the Re-teaching mode is invoked every time the pupil gives an incorrect answer. Re-teaching merely presents a correct method for solving a drill without pinpointing error(s).

We have made the Re-teaching simple and explicit. For this, animation is used. This technique is extremely useful, since it subtly shows the pupil the sub-operations and sub-goals; for example, moving the carry digits backwards, moving the borrow digits forwards, how the numbers increment and decrement during the process, and how the partial product (sub-operations) within the Multiplication operation works.

3. Model-based Coaching mode

The Coaching mode is executed after the Re-teaching mode has been successfully presented to the pupil. The Coaching is invoked every time the pupil gives an incorrect answer.

The central idea underlying Coaching is to monitor the pupil's performance and to check if an error is made that could be corrected by teaching a particular subskill. In addition it charts the pupil's progress in terms of the numerical concepts and skills that s/he already possesses.

The model-based Coaching has been developed to determine a pupil's error(s), then recursively remediate these error(s) one by one by generating drill(s) involving these misconceptions. The aim is to creat the pupil-knowledge model.

Hence, the pupil's error is taken as a basis to generate the next drill(s). Therefore, the drills generated will depend on two things; **firstly**, the type of error (based on the Bugs Catalogue) and **secondly**, the type of drill. This will have the same form as the previous drill, in which the pupil has failed to give a correct answer.

The process of asserting the pupil's error(s) and recursively remediating these error(s) one by one is represented internally as a 'Fuzzy Tree'. This formalism enables the information present in the interaction with the pupil to be represented so that the pupil knowledge model can be built.

4. Pupil Profile mode

The teacher must have an adequate 'model' of the current state of the pupil's domain knowledge, problem-solving abilities etc. Only then can the teacher provide relevant advice and set drills which help the pupil to debug the aberrant part of his/her knowledge. Thus, the teacher must be capable of using the information present in the interaction with the pupil in order to build a Pupil Profile.

So far, the Coaching Strategy guides us to produce a summary of the pupil's performance. The goal of the Pupil Profile mode is to create a more global conceptual diagnosis of the pupil's overall performance, rather than being restricted only to giving information about individual errors.

The Pupil Profile mode performs several different types of analysis. The first involves generating overall results for each pupil, such as the number of drills solved correctly, the number of drills solved incorrectly. The second type of analysis involves pinpointing the major areas of weakness among the common bugs. Thus, this type of analysis attempts to classify errors in clusters according to the most common bugs for the other three arithmetic operations.

CONCLUSIONS

The following conclusions, arise from adding the Coaching Strategy to the PCMATH system:

[1] The PCMATH system with the Coaching Strategy enhancement could be used by pupils to foster and improve their arithmetic skills.

[2] The Coaching Strategy can enhance the diagnostic capabilities of both pupil and teacher.

[3] The pupil can take complete initiative in solving a drill. S/He can choose a drill or be assigned one. S/He works through the drill step by step.

[4] The pupil can ask the system to select a drill from a list of drills (based on the Bug Catalogue), or can request the PCMATH system to construct a drill corresponding to a specified form.

[5] A Coaching Strategy allows us to produce a summary of the student's performance.

[6] Using the Pupil Profile, the system enables the teacher to discover the major area of weakness in the pupil's conceptual arithmetic skills.

[7] We believe that a Coaching Strategy is sufficient to enable an educationally-oriented package to become a truly self-adaptive system.

[8] According to the recent enhancements, the PCMATH system will now operate on four teaching levels: Exposition, Assistance, Test and Coaching.

[9] Ultimately, the PCMATH system is designed to be helpful and supportive to teachers. It distinguishes among the pupils and indicates which subject the pupil needs to be taught about. So far, the system might reasonably be called an expert tutoring system.

[10] The pupils can be monitored, assisted and advised by the Coaching Strategy model of the PCMATH system whenever they attempt to perform arithmetic drills.

ACKNOWLEDGEMENTS

This work was supported by a studentship from the government of Iraq.

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The Training Agency's 'Artificial Intelligence Applications to Learning Programme'

J P Gillingham*

ABSTRACT

An account of the Training Agency's £3.2m Programme which started in April 1987 on the application to learning of the tools and techniques derived from Artificial Intelligence research. The background will be discussed which led to the formulation of the original aims and to the expectations of the Programme. The activities to date will be described as will the lessons learned from the first range of demonstrator projects. Proposed plans for activities that are likely to be incorporated into the later stages of the Programme will be outlined.

BACKGROUND

Since 1985 we have believed that the UK must come to terms with the application of the tools and techniques which have come from AI research as an extension of existing and emerging learning technologies and methodologies. We believe that we must contribute to the build-up of ideas within British learning organisations towards the 'learning machine' - the intelligent educational or tutoring system.

This drive led us into a number of projects largely based on the application of Expert Systems to training and educational needs. We funded projects to produce expert systems in:

. report writing (Sheffield Polytechnic)
. fault-finding and comparison with existing training methods (ICL)
. stock and inventory control for retail managers and supervisors (Datasolve and B&Q)
. taxation for managers of small businesses (SYSTEM)

A Further Education College (Kingston CFE) was funded to produce a starter pack for the use of Expert Systems across the FE curriculum and to conduct training in the use of Expert Systems for trainers seconded from industry.

Another ambitious project attempted to produce a generic training needs analysis system (AI Ltd). Whilst a paper model was produced, the final outcome was a prototype course planners assistant.

These projects gave an insight into what was possible and in August 1986, the TA agreed to fund a programme - to run for 3 years from April 1987 until March 1990, with a budget of £3.2 million. There have been some slippages outside our control and the programme is now likely to go on until the end of 1990.

I shall now give an account of the programme so far; some of the lessons we have learned and some of my thoughts as to where we may be going in the future.

The original aims were:

. to explore the use of AI techniques in developing more effective training methods
. to accelerate the appropriate application of AI techniques to learning
. to encourage UK industry to become more competent and competitive by providing evidence and demonstrations of more cost-effective means of training

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PHASE 1

Advised by a cross section of experts from academia and industry, we started the first phase in April 1987 - it had 3 elements:

- evaluation
- survey projects
- demonstrator projects

Evaluation - two parallel external evaluations are running for the length of the programme, there are both formative and summative and concentrate on the programme's impact on the educational and industrial sectors respectively. (National Council for Educational Technology and Sheffield City Polytechnic).

Survey - survey projects were conducted which took the form of a mapping exercise of AI tools and intelligent courseware and a skills inventory of the key people who could enable, influence and facilitate AI applications to learning. (2 Datasolve led Consortia).

Demonstrators - 3 were selected from 58 proposals, all submitted to meet strict criteria in response to over 300 invitations to tender:

- an expert system on customer complaints procedure for use by catering students and small businesses (Granville College)
- computer based training and simulation linked with an expert system to train staff to operate and maintain process plant (Rediffusion and Tate & Lyle)
- an expert system training package to help owner-managers in business planning (National Computing Centre and Durham University Business School)

A number of lessons have already been learned to date from each of these demonstrators. Such lessons are of various degrees of significance and generality. A sample of some of the early lessons are:

- expert system courseware can be produced within the limited resources of a Further Education college
- the knowledge elicitation process changed the idea of what could be done and helped determine a learning strategy
- expert system based learning material can be used interactively with individuals and small groups BUT much wider trialling is necessary to see if such materials can be used independent of the developers
- a method has been devised to integrate a commercially available shell, with a CBT authoring language and simulation
- an integrated, interactive system incorporating an expert system shell, CBT and simulation has been built using a keyboard and a mouse with material displayed on two screens. An evaluation is to be conducted into the learning effectiveness of such a system
- inputting real business figures has encouraged small business users to interact with a training/advisory system over a longer period than would be normally expected while in a learning mode
- there is strong evidence that small business users will accept advice and guidance from the training/advisory system better than from human consultants
- the human machine interface is poor compared with conventional computer based training
- an advisory expert system is not conventional training - extensive trialling is needed to determine how much users actually learn from such systems
- the use of a commercal expert system shell limited the scope of the domain that could be addressed

After further consideration and advice 4 more demonstrators were selected from the original 58 but were renegotiated to comply to additional criteria. These were:

- training in Statistical Quality Control (Liverpool Poly and Unilever)
- embedding Operational Support for a business software package (Logica)
- management training in Quality Management (Cranfield & BHRA)
- courseware for decision makers in Information Structuring (Glasgow University and Clydesdale Bank)

To date some of the lessons learned are:

- it has been found possible to incorporate a simple student model into an intelligent help system which can learn from the use made of it and adapt its responses
- it is also possible to incorporate a simple model of forgetting into an intelligent help system
- it is much more difficult to embed an intelligent help system that can learn from the use of the main application of the software
- advanced work stations and software development are necessary to tackle such difficult issues as student modelling - shells are unlikely to be able to tackle such issues
- knowledge elicitation and structuring caused the developers to examine several teaching strategies to select the most appropriate one for use in the design of a learning tool
- there are limitations in commercial expert system shells in integrating text and graphics and into portability between machines
- using a propriety expert system shell makes it difficult to develop a good human-machine interface
- a good methodology has been devised for eliciting knowledge in difficult management-type subject areas

PHASE 2

To increase the range of demonstrators we called for further proposals - conforming to tighter criteria. Of the 78 proposals received, 3 were finally selected and started in October 1988:

- an intelligent Interactive Video Simulation on the fire control of large incidents (Blackrod Interactive & West Midlands Fire Brigade)
- intelligent courseware for insurance underwriting incorporating a trainee model. It will also compare a module of CBT courseware with an intelligent one (Kingston Poly & Royal Insurance)
- an intelligent training and advice system for small businesses on employing people - this will also evaluate the use of the Hypercard System for the production of intelligent courseware (Logica)

Another project has been selected from 25 submissions and started in October 1988 which will map the skill needs of managers and trainers who are concerned with taking decisions on, or are responsible for, the implementation of intelligent learning systems and courseware. It will also design, run and pilot a course for them (System Applied Technology Ltd).

A two day seminar was held to consider how AI can be applied to training by suggesting a taxonomy of training domains and mapping knowledge representations so as to guide, inform and map the remainder of the programme. This has been written up as an Occasional Paper (ESRC InTER).

A survey is being conducted by a consortium - the DISTIL Survey - which will carry out a formal survey of research and development projects in the UK and overseas in which AI techniques have been applied to, or are related to, learning. This will provide an accessible resource in paper and electronic form to inform and guide the activities of the rest of the programme.

PHASE 3

At the time of writing this paper the third phase is still under discussion. Some first thoughts are given below, these will be brought up to date during the presentation at the 6th ICTE:

- further demonstrators - this time with explicit requirements for a specified conbination of learning/training domains and issues, industrial/educational sectors and development environments

To help map our existing demonstrators and help determine likely areas for further work, two grids have been devised as a way of mapping such issues. Figure 1 relates learning methods, styles and issues to sectors. Figure 2 relates learning methods, styles and issues to AI development environments, tools and techniques. The maps will be refined during the negotiation of the third phase of the Programme.

FIGURE 1

Learning Styles and Issues (Number of Applications)		SECTORS (No of demonstrations)							
		Small Businesses (3)	Managerial (5)	Manufacturing (2)	Financial (1)	Services (1)	Further Education (2)	Engineering / Heavy Industry (0)	Public Utilities (1)
Tutoring / Advising	(8)	2 10	7 6 10 2	3 6	9	1	1 11		
Intelligent help	(1)	4							
Simulation / Role Playing	(5)		5	3 6		1	1		8
Student modelling	(5)	4	6 5	6	9		11		
Discovery learning	(3)	10	5				11		
Practice	(5)			3 6		1	1 11		8
Comparative studies	(1)				9				
Machine learning	(2)	4					11		
Knowledge elicitation / engineering	(5)	2	7 6 2	6		1	1 11		

FIGURE 2

Learning Styles and Issues (Number of Applications)		AI DEVELOPMENT ENVIRONMENTS / TOOLS / TECHNIQUES / ENHANCEMENTS (No of demonstrations)						
		Commercial Expert System Shells (4)	Proprietary Expert System Shells (2)	Hypertext (1)	Advanced Workstations Tools / Environments (4)	Authoring Tools (6)	Enhanced CBT (2)	Enhanced Interactive Video (1)
Tutoring / Advising	(8)	1 2 3 6	7 9	10	11	10 11	3 9	
Intelligent help	(1)				4	4		
Simulation / Role Playing	(5)	1 3 6			5	8 3	3	8
Student modelling	(5)	6	9		4 5 11	9 4		
Discovering learning	(3)				5 10	11 10		
Practice	(5)	1 3 6			11			8
Comparative studies	(1)		9			9		
Machine learning	(2)				4 11	4		
Knowledge elicitation / engineering	(5)	2 6 1	7 7		11			

It may also be relevant to consider issues related to the scale of such projects and the degree to which they lead to the development of generic tools, as opposed to the production of context-specific demonstrations.

- further skill mapping and training projects, identifying and addressing target audiences such as decision makers, training managers, courseware producers, software producers, knowledge engineers etc
- awareness - awareness-raising activities, to address issues such as: What is there to be aware of? What do managers, trainers, developers, designers do when they become aware? What account should be taken of other initiatives and networks? What is the right timescale? How do we get commitment and ownership to such ideas? What media do we use - print, video, starter packs, case studies etc?

Whatever the future of our programme, I am certain that we must move forward. We will certainly not reach the holy grail - the complete IES or ITS. But perhaps we will produce demonstrations and examples of various combinations of the elements of such systems - in student modelling, subject domain expertise, learning styles and strategies, HMI issues and the inter-relationship and management of such combinations. The key will perhaps be in how we raise awareness of the possibilities by disseminating the results of our activities and the timing of such activity.

HYPERTEXT AND KNOWLEDGE-BASED SYSTEMS FOR EDUCATION

J.H. Briggs, C.P. Tompsett *

ABSTRACT

Knowledge-based systems are designed to handle knowledge, and applications of this knowledge, in the same way as humans. They offer the opportunity to create a learning environment in which the learner interacts directly with an active model of knowledge that they are required to learn. Hypertext allows a wider range of knowledge, not encompassed within typical knowledge-based systems, to be examined or investigated by a reader or student. It offers a coherent model for the integration of a variety of media and knowledge sources into a learning environment, although it lacks the facilities to support the students exploring this environment. Unifying the two paradigms offers the advantages of flexible exploration of a hypertext environment where guidance and selection of relevant material is provided by the conceptual structure of the implicit knowledge-base that was used to develop the document.

HYPERMEDIA AND EXPLORATORY LEARNING

Educationalists have expressed an enthusiastic welcome for the arrival of hypertext and more generally hypermedia. No longer is the teacher constrained to the limited resources available within a few textbooks and a handful of films but is now offered an almost unlimited resource centre open to each student. Linking the concept of hypertext to the technologies of satellite broadcasting and CD offers a learning resource of unparalleled richness to education.

Non technical subjects - literature, religion, the humanities and politics, to suggest a few only can now access source materials that lie at the heart of the study of these subjects. The critical question that remains as yet unanswered is whether these resources can become a genuine exploratory learning environment or whether they will remain as under-used as the typical school library or archive of art and photography.

THE HYPERSPACE MAZE

The most efficient users of information resources today are those who already know what knowledge is available from the resource. They understand how related knowledge is conceptually organized and how the resource is logically structured. The logical structuring determines the physical arrangement of the information and all that hypertext/media offers is a richer mapping of the logical structuring of the information.

In education we are faced, de facto, with the problem that those who will use the resources do not have a clearly defined structure of how the information is conceptually related or of how the information is organized.. Although exploratory learning is not the only educational application of hypermedia it is the most exciting and this approach implies that the exploration is of new knowledge and a not a re-examination of what is already known. From this point of view the hypersystem is a hyperspace maze of information. The rooms of the maze are nodes at which information is located and the doors leading to further rooms represent links between the rooms that are allowed.

Learning in this maze can only take place if the student is able to navigate the maze efficiently but major problems arise when a student is presented with a new large hypermedia system. The progress of the student from node to node is made as a series of decisions based on the information that is available at a node and the links that have been created by the author. The dangers facing all users of large hypermedia systems arise from the very freedom that is allowed to them. There is nothing to prevent the associations that link two adjacent nodes being used to traverse an incoherent collection of information nuggets. With a large

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hypermedia system you can progress from *Beethoven* to *piano* to *ivory* to *elephant* to *India* to *tea* to *coffee houses* to .... and end up totally lost, possessing some knowledge but having gained nothing from the hypermedia system. Too much information has been ignored and too much has become irrelevant for the associations between pieces of information to support either learning or insight.

THE AUTHORING PROBLEM

Although the hypermedia concept provides an ideal model for the way in which we wish our own knowledge to be recorded this ideal is based on post hoc considerations. If we are asked to describe why we leap from one idea to the next we quite happily provide the connecting link (as with the early views of semantic nets ref 1). However, if asked to specify in advance what direct links there should be from one piece of knowledge to any other possible pieces of knowledge, we realize the lack of methodology that exists for the generation of large hypermedia systems. Indeed, without a coherent methodology, many current interactive systems could claim to be hypermedia systems. The most restrictive forms of computer based training contain the same ingredients (nodes and links) even if the links are non-democratic (you do not choose which link to follow). Hypermedia is still an ideal but not yet an identifiable approach to information structuring.

Authors face similar problems in constructing hypermedia systems as users do in making use of them. Above a certain size the author looses track of which parts have been completed and which elements remain to be extended. Structuring is advocated before writing but this presupposes that the material does not already exist. As hyper-documents grow the combinatorial complexity of providing links increases dramatically. The authoring problem is the problem of creating large documents with sufficient openness but sufficient structure to guide the authoring of the system itself.

This problem is symptomatic of the current total lack of principles and support for the writing of hypermedia systems. When it is answered, the author (and teams of authors) will be able to create systems within an editorial structure that manages the addition of nodes, automates the provision of links and provides structures and boundaries to the authoring process.

The intelligent creation of links is the most difficult process required of the author. At this stage it is worth categorizing links into three types - global, generated and hand-crafted. Global links provide direct access between nodes irrespective of the information content or structure of the nodes. An example of such a link would be a 'find next occurrence of this word' link, based strictly on the existence of the word in a piece of text and bearing no relationship to the meaning of the word and context of its use. Generated links are created by the system, are more restrictive in their action and presume that the author has made decisions about the purpose and function of a node. A simple example would be the use of keywords to describe the approximate content of a node. Although this is similar to the previous type, these links provide semantic associations rather than syntactic ones. The authoring decision in this case is the selection of the set of keywords. Such a decision makes implicit assumptions about the purpose of recording the information. The third type, hand-crafted, are the individual, non-systematic links created by the author. Such links may encompass the most interesting experiences in using hypermedia systems but are the links most difficult to plan coherently and fail to map consistently onto the document as a whole.

Our interest is in the application of knowledge-based techniques to the authoring problem and the benefits that this approach offers to the guiding and assistance of students in browsing the resulting system. We are approaching this problem from two related directions. Firstly we have worked on the construction of an intelligent tutoring system which included a large quantity of partially structured information and video images that could be browsed by the students. Secondly we are constructing a large hypermedia system related to a public enquiry for which we start with a large number of documents and images that are to be organized on knowledge-based principles into a hypermedia system.

KNOWLEDGE-BASED BROWSING

The work on intelligent tutoring continues from work on the KBET project (ref 2) for training in the engineering field. The learning materials for this intelligent tutoring system prepared by courseware authors was only partially represented in knowledge base terms. The choice of what to represent has been described as a distinction between the formal and informal aspects of the subject material (ref 3). The formal material is represented in the knowledge-based system for exploitation and reuse by the inference mechanism. Informal knowledge is incidental, 'once-only knowledge' that is not cross-referenced in the rest of the material. Additional knowledge is represented in video images - this again is described partially in knowledge-based terms with further information in the images providing additional informal knowledge for the student.

Browsing of this material is supported through the use of a concept network with specific items of information, such as video examples and text commentary, available as the student browses. These 'concepts' can be viewed as the nodes of the hypermedia system and the items of information provide the information available at the node. The concept network provides an underlying knowledge-based framework to support browsing and two separate modes of use (unfocussed and focussed) are facilitated by the detailed form of the semantic net (ref 4). The major conceptual structures describes frame-like concepts in terms of their major roles(slots). Each role leads to a new concept providing a consistent set of links for traversing the knowledge-base (unfocussed browsing). This structuring provides both local and high level structuring to the knowledge, ensuring that at any node the relationship of the information to the overall purpose of the system is both clear and consistent. Hierarchical structuring of the concept network provides the higher level organization of the knowledge and each concept can be related to more general concepts in a deterministic fashion.

These links provide a conceptual structure that allows each of the documents/images in the system to be accessed in a consistent manner, using generated links. Further global links are provided to mimic the global access methods that are typically used - dictionaries, glossaries etc. Hand-crafted links are only present as serendipitous, self-contained experiences which are not expected to be generalizable in their character.

Additionally the system defines a formal specialization of some concepts - defined through a formal restriction of the potential roles of a concept. Such specializations allows the browser to restrict the knowledge presented in a logical manner. In one sense the framework is more limited but the system can now provide more precise information. The use of these specializations allows the browser to focus in on some particular area of information. This alters the structure and content of the semantic network, providing less variation as the student progresses but also allowing the system to relate information by analogy and contrast (in the sense of Goldstein ref 5). A student's position in browsing the network can then be presented in terms of the set of specialization decisions that have been taken and relative position to the high-level concepts.

The problem for new students browsing the network is still, however, the vast range of information available if browsing is unconstrained. Four approaches are possible with this knowledge-based structure to systematically restrict the nodes that are accessible and the material that is presented. The use of focussing techniques related to information that is available (as above) is just one such method. Two further techniques, bottom up and top down restrictions on the hierarchical structure, limiting browsing to sections of the network are both simple to achieve and consistent with natural teaching strategies. A fourth strategy, we have termed 'slicing', was founded on user modelling concepts but is applicable in knowledge base terms alone. The knowledge base was designed to represent many facets of the knowledge concerned, from economic aspects to operating instructions. For various 'users' areas of the knowledge base were defined to be irrelevant and these aspects of the knowledge were 'closed off' (with soft boundaries that could be broken if the user 'forced' the system to open them).

Each technique provides a coherent approach to limiting the size and scope of the nodes and hence the information that is initially accessible. The knowledge-based structure then allows for systematic relaxation of any of these restrictions as the student explores the knowledge.

PURPOSEFUL EXPLORATION

Our interest in hypermedia systems pre-dates the study above and has involved provision of knowledge-based information for secondary school students in the humanities (ref 6). The focus of this work is exemplified by the study of students querying a knowledge-base of information concerning a murder. The purpose of the exercise is to develop investigative and reasoning skills appropriate to historical understanding. This work has produced significant results but has also highlighted the problems that will arise when the size of the information base is expanded on the scale that is now feasible for hypermedia systems (ref 7).

Key issues relate to supporting the students in their own exploration of the knowledge and of these two are critical. The first of these requires that the student is able to find out , without over-emphasizing the optimum route what knowledge might be found within the system. Every system will have bounds and it is naïve to expect students to anticipate exactly the knowledge that is potentially available. Secondly it is clear that many students find systematic exploration difficult - even with small hypertext systems they frequently wander randomly through the nodes of information. The optimum solution is to provide an interactive browsing mechanism that controls the student's access to the knowledge without over-constraining the sequence of nodes. Students should be able to browse along paths that offer new knowledge complementary to what has already been encountered.

The existence of links needs to be controlled to limit the nodes that appear to exist and the control is exercised on the basis of a student history and knowledge about the purpose of the links. As each area of the knowledge is opened it is the possible to establish some appropriate search goals for the student to set targets for further exploration and provide intelligent assistance for students is required.

The major hypertext system that is now being created is the representation of the knowledge surrounding a public enquiry. This has been selected as an example of documentary material that even intelligent people find hard to decipher - providing a suitable challenge to demonstrate the power of the hypermedia metaphor. The documents include statements made by witnesses, documents presented by experts, biographies of key individuals, assessment of evidence, cross-examinations and decisions. A conceptual network describing the key concepts that are relevant to understanding the enquiry will allow documents, or more precisely sections of documents, to be accessed progressively and intelligently by the student. Standard global links will also be provided to allow for normal access to documents (such as reading a complete document from beginning to end if required).

SUMMARY

Exploratory learning in a hypermedia system is only possible if the links that are defined represent some knowledge-based association and knowledge-based material is not independent of use. Collection of material is focussed on the intention of the use, and is not absolute. Rather, there is a defined (or presumed) context for the information and any application must fall within that context. Similarly there can be no realistic sense in providing help for students wishing to use hyperdocuments for any purpose imaginable unless this purpose has been identified and links provided to support this use.

1 M R Quillian, 'Semantic Memory' in *Semantic Information Processing*, (Ed) M Minsky (MIT 1968)

2 Knowledge-based Engineering Training (ALVEY IKBS 092), partners Logica UK, Imperial College, EITB and Exeter University

3 C Tompsett, 'Education, training and knowledge-base design', Exp Sys 11/88

4 Similar to KL-one as described in R.Brachman 'On the epistemological status of semantic nets' in *Associative Networks* (Ed) N Findler (Academic Press 1979)

5 I P Goldstein 'The genetic graph' in *Intelligent Tutoring*, (Eds) J S Brown & D Sleeman, (Academic Press 1982)

6 J Nichol, J Briggs, J Dean, C Tompsett, 'Computing for everyman or computing for applications', in *Microcomputers in Education 2*, (Ed) E Ramsden (Ellis Horwood 1982)

7 J Briggs, DETECT - 'Watching the detective' (submitted to AI in Education, Amsterdam 1989)

A PROTOTYPE COMPUTER TUTOR FOR FRACTIONS

Hyacinth S. Nwana*

ABSTRACT

Mathematics has provided a very suitable domain for Intelligent Tutoring System (ITS) research, some examples being BUGGY, DEBUGGY and the GEOMETRY Tutor. However, though many tutoring systems have been constructed for the domain, there still exists no consensus on any approach for the design of such systems.

In this paper, we examine several reasons why attempts in this vein are either nonexistent or inadequate. We very briefly review the existing approaches in the domain of mathematics. So far, we have been investigating into an alternative approach to constructing ITSs in mathematics which supports an interactive style and which improves on at least some of the these shortcomings. We therefore briefly present an ITS for fractions (FITS) which is currently being developed based on an alternative approach, together with some illustrations of its current capabilities.

INTRODUCTION

There seem to be two main reasons for the present lack of success in establishing a credible approach for constructing ITSs as a whole in the domain of mathematics.

1. Cognitive scientists have failed to come up with a universally acceptable theory of instruction and learning (ref 13). Most current theories of instruction and learning are woefully inadequate in their ability to have any impact on the construction of ITSs. "What is needed are a stronger theoretical foundation based on a deeper analysis of acquisition of complex learning-to-learn, conceptual and performance knowledge" (ref 7). This is one of the reasons why the development of ITSs, not only for mathematical domains but for all other domains, is still in its infancy and this makes the area increasingly vibrant.
2. There has been little research into providing such a credible approach (or approaches) (possibly because researchers are waiting on a more universal theory of instruction and learning). Only a handful of researchers have attempted to provide general frameworks for ITS construction (e.g. refs 6, 9 & 14). Most ITS designers have actually focussed on various components of the ITS architecture, such as the student model, the domain expert or the user interface, as stand-alone parts rather than on the effectiveness of the system as a whole (refs 3 & 5). For example, Brown & Burton (ref 4) in BUGGY and Sleeman & Smith (ref 10) in LMS focussed on student modelling. This is by no means to belittle the work done on the various components of the ITS but merely to say that there is sufficient evidence in the literature to suggest that it is not trivial to incorporate these resulting stand-alone components into fully fledged ITSs. For instance, Sleeman (ref 12) reports that even though PIXIE (a Lisp-based ITS for algebra) "has a model for student's problem solving, it has not so far proved possible to remediate very effectively". Nevertheless, work done on these components has been invaluable in some of the more successful existing ITSs and will surely continue to be so.

Realistically, the solution to the first of these two problems is still well away, that it would probably be better for researchers to concentrate more on the second problem in the short term, with more experimentation on various approaches. Perhaps some of the energies being spent by researchers working on various components of the ITS should be redirected towards this goal. In effect, ITS experts should probably adopt more of the 'engineering approach' rather than the more rigorous scientific style. Wenger notes that, as a developing field, ITS needs more laboratory work (ref 13). He argues that the pragmatic needs that motivate ITS research are very concrete and immediate, and justify such laboratory experiments. Nevertheless, the crucial work being done towards the provision of a more universal theory of instruction and learning should by no means be neglected.

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BRIEF REVIEW OF EXISTING APPROACHES

Current approaches to the construction of ITSs in mathematics can be grouped under two main headings:
1. The mal-rule approach
2. The model-tracing approach

The mal-rule approach

The steps in this approach are noted in Sleeman (ref 11). They are:

1. Analyze protocols from students in the target population solving typical tests and codify their difficulties/misunderstandings. (This may sometimes involve detailed 'clinical' interviews with students).
2. Create databases which include codings of the mal-rules (or bugs) observed in Step 1.
3. Implement and use the ITS with students and in particular note student errors which are *not* spotted by the system.
4. Carry out detailed interviews to determine the nature of these errors and code them as additional mal-rules. Steps 3 and 4 are repeated until the system captures the majority of the bugs which occur with the target population.

However, in Nwana & Coxhead (ref 8), we highlight the inadequacies of the mal-rule approach for constructing tutoring systems for other more 'complex' mathematical domains. We would like to refer interested readers to this paper to avoid repeating ourselves here again.

2.2 The model-tracing approach

The main features of model-tracing are the following (refs 1 & 2):

1. The tutor constantly monitors the student's problem solving and provides direction wherever the student wanders off path.
2. The tutor tries to provide help with both the overt parts of the problem solution and the planning. However to address the planning, a mechanism had to be introduced in the interface (in this case menus) to allow the student to communicate the steps of the planning.
3. The interface tries to eliminate aspects like syntax checking which are irrelevant to the problem solving skill being tutored.
4. The interface is highly reactive in that it does make some response to every symbol the student enters.

However, in our view, this approach also suffers considerable problems which will be discussed elsewhere.

FITS: A TUTOR FOR FRACTIONS

FITS is the acronym for Fractions Intelligent Tutoring System, which we are currently developing to test out a new approach suggested in Nwana & Coxhead (ref 8). FITS is a PROLOG-based system running under Quintus Prolog on a SUN 3/160 workstation. It is not possible to give a full description of the entire system in this paper; however, some of the key features can be demonstrated via excerpts from the interaction between the tutor and a hypothetical student. Comments are in italics.

[The system would begin with pre-testing and appropriate pre-teaching.]

Tutor: Solve 1:1/4 + 2:1/2.
What operation do you want to perform?
List of Operations
  1. Add equivalent fractions
  2. Cancel fraction
  3. Find equivalent fractions
  4. Sum loose numbers
  5. Unvulgarise fraction
  6. Vulgarise fraction
  7. Rewrite fraction
WHICH <1..7>? *[Demanding the student's intention/plan].*

Student: 2.

Tutor: Oh no! There is no fraction to cancel. Try again. *[Hint].*
What operation do you want to perform?
...

Student: 4.

[Could have equally chosen to find equivalent fractions or to vulgarise fractions. System can support various idiosyncratic ways of solving the same problem, hence no one 'correct' solution].

Tutor: Fine Mary. Perform operation.

Student: 3 + 1/4 + 1/2

[Could have typed in 3:1/4 + 1/2 or 1/4 + 3:1/2 or 1/4 + 3 + 1/2. Note these various possible idiosyncratic inputs are possible due to explicit fractions knowledge representation.]

Tutor: Correct. What operation do you want to perform?

...

Student: 3.

Tutor: Fine. Perform operation.

Student: 3 + 2/8 + 4/8

[Note these idiosyncratic inputs: could also have typed in 3:2/8 + 4/8 or 3 + 1/4 + 2/4 or 3:8/16 + 4/16.].

Tutor: Correct. What operation do you want to perform?

...

Student: 1.

Tutor: Fine Mary. Perform operation.

Student: 3 + 6/16.

Tutor: Not Correct. You seem to have added both numerators and denominators to provide the numerator and the denominator of the fraction respectively. *[Classic fraction error].*

Remember you add equivalent fractions by just adding the numerators and placing this sum over the denominator. Study this example to help you. 2 + 1/4 + 2/4 -> 2 +3/4. *[Hint].*

Remember your current step is 3 + 2/8 + 4/8.

The operation to perform is adding equivalent fractions.

Student: 3 + 8/64.

Tutor: Still not correct. You seem to have multiplied the fractions together instead of adding.

WELL I THINK YOU CAN DO WITH SOME HELP.

Add the numerators and place the sum over the denominator for the problem 2/8 + 4/8.

Student: 5/8.

Tutor: Not Correct. Add the numerators: 2 + 4 = ?

Student: 6.

Tutor: Correct. Place this value 6 over the common denominator 8.

Student: 6/8.

Tutor: Correct. Now add this fraction sum 6/8 to the loose number 3.

Student: 3 + 6/8.

Tutor. Correct.

WE RETURN TO WHERE YOU WERE. Remember you were at the stage: 3 + 2/8 + 4/8. You chose to perform adding equivalent fractions. Now with the help I have given you, Try again.

Student: 3 + 6/8.

[Note the use of the explicit knowledge represented in the system Also note the different tutoring strategy which FITS adopts here. The system could therefore switch to tutoring a different aspect of mathematics, if necessary, before returning to tutoring fractions].

Tutor: Correct. What operation do you want to perform?

...

Student: 4.

Tutor: There are no loose numbers to sum Mary. Try again.

Student: 1.

Tutor: There are also no equivalent fractions to add.

Try cancelling fraction fraction Mary. *[Strategy here is to tell the student what to do].*

Remember your current step is 3 + 6/8.

[The system notes in sthe tudent model that Mary has shown evidence of a lack of understanding of when to cancel fraction].

Student: 2.

Tutor: Fine. Perform operation.

Student: 3 + 3/4.

Tutor: Correct. What operation do you want to perform?

...

Student: 7.

Tutor: Fine Perform operation.

Student: 3:3/4.

[After this the system would display the student's full answer, with a comment on its efficiency, followed by its 'optimal' answer.]

CONCLUSIONS

We have noted that there is, perhaps, not enough research into providing a credible approach (or approaches) to constructing ITSs; most researchers have focussed on various components of the ITS architecture. We have argued in this paper for researchers to direct more of their energies towards this goal: for more experimentation on various approaches. Next, we very briefly reviewed existing approaches to constructing ITSs in mathemaics. Finally, we presented some illustrations of a tutor for fractions (FITS) which is based on a new experimental approach. Further developments are in progress; results so far are encouraging.

ACKNOWLEDGEMENTS

This research is supported by a Cameroon Government BS grant (Cameroon Embassy, London) and a British Government ORS award. The author is also very much indebted to his supervisor Dr. Peter Coxhead.

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VERTICALLY INTEGRATED TELECOMMUNICATIONS NETWORKING

G.S. Fain

ABSTRACT

Technology is transforming education. Central to this transformation is the conceptual and structural application of the vertically integrated educational network. This type of network is built on knowledge ladders that allow individuals to move, at their own pace, deeper into a particular field and instantaneously across fields in ways which are otherwise not possible. For example, with the ease and speed of a few keystrokes, the independent user can "go" from reading Federalists Paper #10, to the autobiography of James Madison, to a live forum comprised of federalists scholars. And the user could be in an inner city high school, college town or sitting in the public library of a rural town. The technology has made this transformation of education possible and in all likelihood unavoidable. Moreover, these changes in education will impact civilization well beyond the scope of responsibility traditionally assumed by teachers at every level of instruction.

Computer networks clearly demonstrate the need for education that is non-specific to both population and situation. All eight year olds do not learn in the same ways, and the process of education does not cease for those who graduate from high school or college. Learning, the accessing and creative manipulation of knowledge, along with the human desire to communicate, is a matter of life long development and curiosity. The way individuals discover knowledge and communicate with the world around them is more a function of their interests, abilities and values than it is a function of their age or place of residence.

It has become evident that the technology necessary to build sophisticated vertical networks responsive to needs within education is not only readily available but it is also extremely powerful. Powerful in the sense that the way information and communications are structured will, in a meaningful way, shape the way people learn and think.

These new networks, designed on certain assumptions of how people learn and communicate, require that we think, learn and communicate in particular and new ways. The role of teacher and school, which has been primarily founded on age appropriate, homogeneous groupings (horizontal groupings) needs to be examined. It is therefore essential that educators become invested in this research as the implications for educational epistomology, schooling and more comprehensive educational practice are not well understood.

This presentation will include several case studies in vertically integrated telecommunications networking that have been implemented by the SCHOLE network operated by the School of Education at Boston University.

ELECTRONIC PUBLISHING, IMPACT AND FUTURE

Martin G. Heltai*

Introduction

The world of personal computers has now spanned a little more than a decade. I need not elaborate on this technologies enormous impact, except to say that the rapid improvement in the personal computer's Random Access Memory (RAM) capacity and the increase of affordable large capacity permanent storage, has allowed software developers to to become more and more versatile in providing programs with an increase in user flexibility and transparency. The development five years ago of the Laser writer which is capable of very high quality output, has spawned new industry which was dubbed Desktop Publishing. In this paper I will endeavor to shine a little light on this industry's impact and future. I will explore two areas, first explore the future of the technology and second how we in the academic world might communicate through this medium.

Desktop publishing today

I remember being overwhelmed by my computer's 512K RAM capacity and wondered what possible use could anyone have for a personal computer with a greater capacity. Today I feel somewhat constrained by a computer with a memory configuration four times that size. The constraint comes because the I have to come to rely on this technology for much more than just word processing and number crunching trough spreadsheet programs. In fact my job and indeed the job of many in my department have been redefined because of the capacities of the personal computer. Ten years ago when I purchased my first computer I never thought that this technology would propel me into the world of publishing. Today in my department we/I produce, through a small network of personal computers and two Laserwriters, very sophisticated camera ready publications. I have enough humility now to realize that this is not the end but rather the beginning of Desktop publishing. Indeed I predict the the word "Desktop publishing" is only transitory. Within a few short years this method of communicating will the the norm rather than the exception.

The capacity to formulate Ideas, play "what if" with them, create images to illustrate them combine them with other Ideas and images, format them into well presented documents and disseminate these Ideas to the desired audience, is what Desktop Publishing is about. In traditional publishing the generation of Ideas,the creation of images, the formatting of the information and the dissemination were performed separately each by skilled individuals who applied their craft to these separate tasks. All of these tasks can be combined and performed by one Individual,

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Martin Heltai is the director of Media Services at The University of Texas at Arlington, UTA Box 19647 Arlington, Texas 76019 USA or individuals with complementing skills performed interactivelyon a network of computers. The finished product can either be disseminated through computer networks or output for traditional printing and distribution.

Technological synergy

Since the past developments in this field were largely guided by the improvement of the technology we can safely assume that the future will be no different. As the computers grow larger and faster software developers will use these added capacities to produce complex programs that will be even more transparent for the user. High speed processing with the combination of high RAM capacity and flexible mass storage such as the optical laser disk were introduced this past fall by Steve Jobs and the NeXT computer. The innovation is not only in its speed RAM capacity and data storage. It is in its object oriented programming capacity. This could very well mean a drastic reduction of cost and rapid increase of programs available for small computers.

New technologies are entering our lives at a dizzying pace. It seems that the only thing that is finite is the time we have to make use of all of these time saving devices. Since what we run out of is time the most important attribute of any new technological development is how it will ultimately help us to perform our work more efficiently. In our work we require that the information presented to us be not only well thought out and important, but also presented in a manner to enable us to absorb the information in the least amount of time possible. The prevailing means for dissemination is still the printed word. Mostly because we still are more comfortable reading information from paper rather than a CRT. This however will change rapidly.

There are two methods for transmitting information through telecommunication links. First there is the the direct computer to computer networks which work well for the transmission of text documents. The transmission of formatted "Desktop" published information is too slow. Currently at the standard rate of 2400 baud a single page from a desk top program can take up to ten minutes depending on it's complexity. The second method, transmission trough Facsimile (FAX) Machines, has not yet been explored by the publishing industry , but I believe will have a significant impact on the publishing industry .

The difference between data transmission between computers and transmitting information to FAX machines is that in a FAX machine the data does not get transmitted but rather the image or "facsimile" of the page. Therefore at the receiving end if the information can be printed out by the user at will as an image document. The quality of these FAX machines is getting better every month. Indeed there an impending marriage between Laserwriters and FAX machines. When that happens and this technology becomes widely disseminated, it will be possible to receive printed material with the speed of data transmission.

Impact

As I stated before, Desktop Publishing is just a beginning, not an end in itself. There is certainly a human impact. The task of setting type will no longer require skilled hands. Printers and publishers will have to understand that their business has much less to do with printing presses than the best possible manner of disseminating information. If they fail to do so it is likely that others than they will be in the publishing business.

As great as the human impact of displacing human beings from their traditional means of earning a living is, it does not come close to the impact of how we generate and share new ide as. The basis of the success of our civilization and the rapid growth of science and technology, is based on the process of generating an idea based on a previous idea and playing "what if" with it, testing the idea and then disseminating the result for someone else to play what if with it. The rapid expansion of scientific and technological developments are directly linked to the speed an efficiency of this communication process. Desktop publishing in association with the new methods of communication represent a quantum leap in speeding up the process.

New ideas which enter the human consciousness change humanity. we now have the tools to disseminate ideas with the speed of light. The problem has been that the it took great effort, expense and adaptability to access these tools. Furthermore the data available on computer network is unorganized and not uncataloged. Publishing information is a process of validating information, organizing it and than target it to the desired audience who have to trust that the publisher has done all that is possible that the information is important and accurate. This process is a tedious one. After the idea has been formulated and properly tested it has to be written up, sent to publishers who in turn send it out to a panel of reviewers who can judge the importance and accuracy of the information. If the idea is accepted than it is sent back to the author for final revisions. The idea is finally ready for typesetting, paste up, printing and distribution. The circuit that I described above can take months to bring to fruition. Today the time that this traditional process take can be significantly reduced. Once again when the author feels that an idea is ready to be launched a, the document can be directly created in publishable form, electronically transmitted to the publisher who in turn would electronically distribute it to the reviewers. When the paper is accepted minor changes can be made by the publisher and the author interactively, and the document is ready either for printing electronic distribution. Since the data is now available electronically, it can enter an electronic data base where it can be easily accessed, searched and reassembled by someone engaged in asking what if.

INNOVATION IN THE SCHOOL LIBRARY MEDIA CENTER

Lucy Ainsley*

ABSTRACT

Originally presented as a keynote address for the 1988 International Association of School Librarianship Conference, this paper investigates the use of technology in both the library media center and the school at-large. The major premise is that educators must create a vision, define the mission and pursue it with passion! Innovation involves the process of change and renewal. This is a critical component of responsive school media programs. The characteristics of exemplary programs and implications of the new national guidelines, are used to explain innovation at the school and district level in this illustrated lecture.

INTRODUCTION

Innovation, by definition, is the process of making changes....adopting new methods, customs or devices. I would submit that much of the innovation we are experiencing in schools of the world today was either thrust upon us by outside forces....or made possible by technological developments outside of education. Over twenty years ago, Father John Culkin of Fordham University suggested that "A lot of things have happened since the turn of the century and most of them plug into walls." (Ref 1) I will return a little later to what is happening with technology in our Global Village but let's focus now on innovative school library media centers and what makes them work. My objective today is to illustrate such a program in words and slides.

VISION, MISSION, PASSION

Last year the American Association of School Librarians and the Association for Educational Communications and Technology published "INFORMATION POWER: Guidelines for School Library Media Programs"(Ref 2). It is a valuable document which outlines the mission, components, and partnerships of an outstanding library media program. As I did my small part as a contributing author, I urged the guidelines committee and writing team to include the concepts of vision and passion. School media specialists must fervently believe that we can make a real difference for the students and teachers we serve.....that is the passion part.

But we must also have a vision of our young people's future and what they will need to succeed in the 21st century. The noted educator and writer John Goodlad expressed some of what I mean at the 1988 American Library Association conference. He said "If a child leaves school at 16 or 17 without to skills to access information, he is crippled for life!"(Ref 3). So the real beginning for an innovative school library media program is to create a vision, define the mission and go to it with passion!

But if you don't know where you are going, you're likely to end up somewhere you don't want to be! A worthy mission which I think we can all share, regardless of where in the world we live, was well stated in the new guidelines. The mission of any school library media program ought "to insure that students and staff are effective users of ideas and information" (Ref 2). Many school districts expand on their mission with philosophy and goal statements. Philosophy and goals are implemented through more specific objectives, especially learning objectives for students. A dynamic media curriculum, working in concert with proactive services, is the core of successful school library media programs.

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Even before our district established a required six year curriculum review cycle for all subject areas, our media staff had completed and revised their objectives twice in eight years. These efforts reflect their sensitivity to technological change and concern for our students. A thoughtfully written philosophy or mission statement and program goals provide a solid foundation for media programs.

PROGRAM COMPONENTS

Now that we have a foundation for our innovative library media center, let's turn to program components. The new guidelines suggest that a school library media program contains "all the resources and activities through which the library media staff translate the mission into reality" (Ref 2). I firmly believe that the library media staff is the most important resource of all! And so that's where I will start my imaginary tour of our exemplary media center. The guidelines suggest three distinct roles for school library media specialists....as Information Specialist, Teacher and Instructional Consultant.

Most U.S. school districts refer to librarians as "media specialists", which is really a misnomer. This key staff member must be a GENERALIST who knows something of learning theory, child psychology, curriculum development, administration, reading guidance, teaching strategies, production techniques, research methodology, bibliographic control, instructional design and technology. In addition to those professional competencies, our district also looks for some special personal characteristics and experiences as we interview candidates for school library media positions. They must have:

- a positive outlook and attitude
- flexibility and a willingness to learn and grow
- energy and enthusiasm for their work
- warmth and openness....good interpersonal skills
- be OTHER oriented...minimize their own priorities
- the ability to work well with adults as well as children
- strong traditional skills in literature, selection and organization
- special interests beyond the traditional...photography, music, art, puppetry, etc.
- an understanding of the media center as more than a place for books....that it is a place to explore, create, produce and enjoy

The best media specialist is a combination master teacher and effective administrator who intuitively knows "people priorities" dictate the appropriate expenditure of time and other resources. They are first and foremost EDUCATORS and secondarily a librarian, media specialist, learning resource teacher or whatever the label. He or she is not only responsive, but proactive....reaching out to integrate the classroom into the media center and the media center into the classroom. The proactive library media specialist should be the classroom teacher's most important instructional resource.

The second program component on our list is facilities. I will not dwell on this area since we all know that adequate space, appropriate furniture and specialized library equipment is essential to the exemplary media center. However, I have seen beautiful media centers empty, dead, ill-used.....while conversely, I have also observed active, exciting programs run in no more than a large classroom. I would argue that the location of the library media center within the school plant is as important as its size. A case in point is one of our elementary centers, staffed by a wonderfully creative media specialist who always has a new project or production going. But because the school's media center is located on the end of a second floor wing, she must travel to the classroom frequently to keep teachers and students involved. Gratefully, we are working on a new center for that building!

The innovative media center must also have an adequate collection for the school population it serves. Books, periodicals, pamphlets, filmstrips, videotapes, recordings, microforms, computer software and new high density storage mediums like CD-ROM are all expensive and require careful financial planning. But I want to call our attention to an essential point that the new guidelines emphasize repeatedly....no one school library media center can contain all the resources needed by students and teachers today. It is critical that we form resource sharing partnerships with other school, public & academic libraries, regional film libraries and state libraries for special materials. At least at the secondary level, students also must have access to online data bases because I am firmly convinced that will be the primary source of information during their lifetime.....both at home and in the workplace.

Hardware or equipment is only important insofar as it provides access to information, and the ability to create or process information. Our innovative media center uses such tools to manage its own functions such as circulation, accounting records, information retrieval, generation of indices and bibliographies....and yes, even overdue lists. It also provides audiovisual, computer and video equipment for use both in the classroom and library media center. Most innovative media centers have a full computer lab for use by an entire class and small groups or individuals.....a sound investment next to equipping every classroom with these remarkable instructional tools.

A dynamic program also has a wide variety of production equipment available for the creation of original media by student and staff....videotapes, slidetapes, transparencies, recordings, graphic materials and so forth. Robert Hilliard appealed to my sense of logic with this statement....."We have been concentrating almost completely on print and have been unsuccessful because the real world in which the student lives and operates is principally a visual and aural one." (Ref 4). We must not only provide the hardware, but also encourage teachers to use, and let students use, forms of communication other than the written word.

Next to staff, the single most important component of an innovative media program is planning. I cannot emphasize this strongly enough! So many school library media centers drift from year to year without direction, without a mission or a vision of what they should be...... and be doing for their clients. The little proverb of "Most people don't plan to fail, they fail to plan" is very appropo here. The innovative library media staff sets long range and short range goals to provide direction for themselves, to secure resources from others and to evaluate progress. Media specialists should also involve others in establishing those priorities.....which is the foundation for partnerships with the principal, teachers and other staff members. The idea of partnerships of all kinds is central to the new guidelines as well as to successful media programs. We do not work or accomplish anything in a vacuum. It is not OUR library media center. It belongs to the school and the community.

It is deliberate planning that makes a program grow and flourish, sometimes even in the face of budget cuts elsewhere. That was the case in the Monteray California Schools, a recent winner of the AASL/EBE Outstanding School Library Program of the Year. Despite Proposition 13 which slashed state aid to school districts, they began a pilot library media program in a few schools, gained community support and then secured a $2 million grant from the state for their program. Their Media Director, Martin Puentes, had a sage but sobering piece of advice for us all in his talk at the ALA Conference. "Just MAINTAIN your program and it dies!" (Ref 5).

Finally, we come to the last program component on my list.....services. What we do and offer is as varied as the communities and schools we serve. A program in the inner-city may loan computers for students to take home, while youngsters in wealthy suburbs have their own equipment. Programs in southern California or Florida must provide library books and other materials in Spanish but New England school libraries have no need for these materials. Truly innovative programs however, go the extra mile to not only offer traditional resources but to also enrich the school community with outside speakers, visiting authors, book publishing centers, cable programming, newsletters and dozens of other creative opportunities which help children, their teachers and parents to grow. We are no longer just repositories of information. School library media programs must grow and change just as our students do.

NEW DIRECTIONS

Change is difficult, particularly for traditional institutions like schools and libraries. But we are being bombarded with change due to what Toffler first labeled as "The Third Wave" and others refer to as the Information Age or Technology Revolution. We must reassess what school libraries should be and what skills our students need for THEIR futures. We must let some of our biases and values bow to their needs. What will happen for instance when these little laser cards, which hold 2 megabytes or 800 pages of text, become commonplace? We will be able to carry a dictionary and thesaurus in our jacket pockets. How will that impact student learning and school libraries? Can satellite communications and distance learning offer opportunities that small schools can't? What is the role of CD-ROM, or even more promising, CD-WORM for the storage and retrieval of information in the learning environment? I don't have the answers but I encourage all of us to start asking the questions and searching together with teachers, administrators and community members. That's how we create VISION for the school library media center. Innovative programs are on the cutting edge of change, not for change sake but because we know our youngster's future depends upon us now.

I was asked to write a chapter for the 1984 "School Library Media Annual" on the changing role of the library media specialist. In that piece I included some personal correspondence which I would like to share with you as a fitting close to a discussion on innovation and change. Our retired librarians keep in touch with their colleagues still working in the trenches on a rather regular basis. A few years ago one retiree wrote "First, I'll commiserate with you RE the micro...ugh...computers...ugh...in the library. Is nothing sacred? Seems like libraries and people are getting even farther from the printed word. What a mistake! I suppose book burning will be next." This was the reply I wrote, but never sent.

Dear Millie,

Your remembrance of friends and colleagues after your retirement through letters is continued evidence of your caring....something I always noted in your relationships with students. Because of that concern, I know you want the best education for youngsters that we can possibly provide.

You know, there have indeed been book burnings as recently as last March when a group of zealous "protectors of morality" piled 30 objectionable titles on a bonfire in Ohio. (Shades of "Farenheit 451"!) Their motivation was to protect established values and reject new life styles. We educators and librarians are more enlightened. We should have the ability to openly explore new ideas, seek better ways of relating with one another, and help children learn in the most effective manner.

But Millie, you can't mean that the printed word is the ONLY way to wisdom and growth? That would be a rejection of new ideas and realities regarding the way people communicate information today. And aren't we school librarians in the business of helping young people to grow through the acquisition of information and ideas?

Microcomputers, cable communications and database networks are just other means to that end. Our children will have to command these technologies or be manipulated by them in their future. And Millie, I truly believe that nothing will ever replace my pocket companion, the book, for the pure pleasure of a good story, the beauty of a poem or the inspiration of a thoughtful biography.

Warm Wishes,
Lucy Ainsley

1. John Culkin, Media & Methods, p 6, Nov. 1966.
2. Information Power, AASL/AECT, 1988.
3. John Goodlad, Address at the ALA Convention, New Orleans, July, 1988.
4. Robert Hilliard, Technology and Education (Institute for Ed. Leadership 1981) p 247.
5. Martin Puentes, Address at the ALA Convention, New Orleans, July, 1988.

LEARNING BY THE INDOCTRINATION OR BY THE DIALECTIC? AN INSIDER'S VIEW

Michael P. Wnuk*

In lieu of an introduction we append here an extensive quotation from an article by Jon D. Miller (American Scientist, March-April 1988, p. 116). Here it is.

> Most Americans hold these truths to the self-evident: Scientific literacy is a good thing and we don't have enough of it. Schools should teach scientific literacy but they are failing to do so.
>
> What strategies can be adopted to make a significant impact on the level of scientific literacy in the United States? First, it is essential to recognize that the middle and high school years are a critical period and that formal schooling is the best vehicle for increasing level of scientific literacy. Second, it is important to begin to create a stronger sense of the urgency of the problem. A fair reading of history would be that Americans respond well to crises and goals. . . .
>
> Given the higher than average awareness of the problem in Congress, I believe that an important first step would be to persuade Congress to adopt a joint resolution establishing a national goal of . . . scientific literacy among high school graduates by the year 2000.

We fully agree with these observations, and now we wish to extend the scope of the discussion by incorporating here our views on teaching science and engineering at the college level.

In the age of mass-produced consumer goods when millions of sophisticated gadgets are made every day and thousands of engineers join the work force each year in order to quench an omnipotent thirst of "more for less", it appears that a new law of nature emerges as an overriding force. Awesome influence of this law stretches far beyond technology and commerce. It affects society at large, threatening the basic human values embedded in each of us. In this context one cannot evade an obvious question: are the numbers more important than the underlying quality? Ultimately, the desire to excel, implanted in the young minds by the so-called sociological environment, leads to an incredible urge to compete, to constantly evaluate and compare, to keep up with the ever growing demands for some elusive measures of success. Stated this way, it seems that there is nothing wrong with such a trend. Perhaps it is all for the better.

But, is it really?

To answer this question let us focus the attention on the centuries old problem of college education of young men and women. To further narrow

*Professor, University of Wisconsin--Milwaukee down the scope of these considerations let us take a closer look at those select few who, upon a graduation from high school, decide to embark on a long and not necessarily smooth journey aiming at a degree in science and/or engineering. On one hand it is true that space exploration, a hallmark of the sputnik era, not only prompted new scientific and engineering breakthroughs, but also inspired young people and helped to channel their talents into the fields of science and math. (Note that this sentence alone might be a useful opening statement for speech suitable for any commencement ceremony, a ritual taking place at well determined intervals in thousands of American universities.)

There is, however, another side of the coin. This becomes painfully obvious when one uses the student pipeline as a source of information, rather than the opening statements of the distinguished speakers appearing at the commencement ceremonies. When one listens carefully, the truth rears its ugly head with an astonishing clarity. Here are some samples: "Teachers don't teach any more, they merely transfer the contents of their notes into the notebooks of students". And, on a little more outspoken key: "The substance of this transfer seldom passes through the heads of either the professor or the students, but then, who cares". Slightly less ironic, but nevertheless authentic sentiments expressed by the students over a number of years in the many conversations I have had with them, run somewhat like this: "Of what use is it to be shown how to solve certain selected problems on the board, only to forget about them after class? Few pay any attention, so hardly anyone learns very much. . . . It's like being on a set in Hollywood, but not being allowed to take part in the action". Unfortunately, this is a common situation. In the learning process the student usually only stares at the professor covering scores of examples--each of which is supposed to drive the point home. Somehow concepts aren't being understood. Why do these well established traditional teaching techniques continue to fail our students? The answer may astonish some, but let's have it out anyhow. One-way communication is no communication at all. In fact, this method of teaching would rather qualify as "indoctrination"--a singularly unattractive, passive, and simply boring way of imparting knowledge.

Indeed, the technique of indoctrination is counterproductive; it defeats its own purpose by failing to stimulate and to provoke an independent thinking process. And without thinking there is no learning.

An antidote for boredom is involvement; the antithesis of the adjective "passive" is the word "active"; and, the opposite of the noun "indoctrination" is "dialectic". We shall realize that asking questions always provokes thinking. And there may be more than one way leading to the answer. This is the very essence of the dialectic as opposed to ready-made, canned learning by indoctrination. It is not necessary to have the answers readily available, right on the spot. Some trial-and-error voyage, accompanied by thought experiments of various kinds, should be required, because this method is extremely beneficial to the student. A young mind seeking to "discover" the truth, or to solve a puzzle, needs a skillful guide.

Finally, the phrase which captures the ultimate failure of the educational system which prevails today in this country, beginning with an elementary school and ending up with the so-called "pile-higher-and-deeper" certification (Ph.D., of course), is the commonly heard, fashionable, and certainly popular comment: "Who cares?" (not to mention some more straightforward invectives usually written on the walls of certain private spots on campus).

In these times top pieces of news are imported from Russia. "Perestroika" is the catchword of the day. We owe it to the students to at least give it a try, and to attempt a "perestroika" in our own engineering curricula, including our approaches to teaching. Again, at a risk of being accused of sounding repetitious, and to avoid any misconceptions regarding the implementation of a perestroika within the academic setting, we wish to emphasize that it ought not be the student body, but the teaching bodies which must undergo the pains of "restructuring" before anything substantial will happen. Can we point the way in which these modifications and changes in teaching techniques should be directed? Of course, there is room for experimentation. And, if we use the student pipeline as a primary guideline, and if we push our inquiry a little further, we will find out that about 90% of students prefer teachers "who make us do things". These are teachers who do not hesitate to plunge the entire class into a discussion of a problem, rather than just show a solution to it. Discussions of this kind should be augmented by frequent use of chalk and board, as these are the oldest and still the most effective teaching aids. Teachers who ask "peculiar" questions, even those who let the students sweat through numerous quizzes, are well remembered. The few teachers who belong to this category accomplish a rare feat: they convey the knowledge required by the program, and somehow in the process manage to impress upon the students bits and pieces of their own personalities. Personal interactions of this kind are well recorded in young minds. They tend to be remembered years after the graduation. Existence of such an extraordinary feedback between the teacher and the student provides a lasting bond, and a treasured reward in the profession of teaching.

I like the perception of changes "enforced" in our daily lives, as expressed recently (the UWM Computer Services Division Newsletter, May 1988) by the director of this college computing center, Neil A. Trilling. Neil says

> We are creatures of habit who, for the most part, enjoy establishing structures and becoming comfortable in a known environment. Change is unsettling and few of us go out of our way looking for it. Our daily lives and our work fall into predictable patterns which, after a while, becomes ways of life.

Changes are necessary, however. It takes great effort to plan new things and to implement them into the existing system, particularly so when the system is well established, and--as usual--when there is a tremendous amount of personal inertia.

Fully realizing that the nature of the topic touched upon in this brief essay is, to say the least, controversial, we leave our views in this rudimentary form. In hope that they will draw certain comments, critique, and criticism. An outrage maybe? Constructive remarks and positive response will, of course, be welcomed with equal pleasure.

INFLUENCE OF BILINGUAL EDUCATION DISCIPLINARY FOCUS FOR IDENTIFYING EDUCATIONAL COMPUTING POLICY PRIORITIES

Brent Edward Wholeben†

ABSTRACT

A study of N=755 classroom teachers (n=113 certified and teaching in the area of bilingual education) from a three-state (USA) region found that bilingual educator priorities for educational computing policy development are distinct from those of their elementary and secondary colleagues, across issues related to curriculum, access, privacy, teacher and student needs, community roles, and software and hardware resource needs. Respondents identified their top-20 priorities for policy objectives from an initial list of 52 objectives; then, selected a list of top-10 priorities from the secondary list of 20 objectives. Lastly, each of the top-10 selections were ranked (1-10). As the range of policy options was restricted (artificial constraints), respondents identified new priorities for separate policy objectives. The linearity of difference between professional educators suggests a strong relationship between disciplinary focus and the differential value of certain policy initiatives. When global contrasts are effectuated comparing educators of exclusive bilingual education assignments to their monolingual counterparts, a "bilingual educator profile" can be statistically constructed in terms of perceived priorities for educational computing policy development.

INTRODUCTION

The International Council for Computers in Education released in 1987 the Code of Ethical Conduct for Computer-Using Educators, a comprehensive statement on ethics and equity in educational computing comprising 52 separate guidelines related to curriculum, access, privacy and confidentiality, teacher, student, community, organization, software, and hardware. Would these guidelines be accepted by the education profession? Which issues would be considered sine qua non requirements? Which statements might be relatively unstable during periods of constraint? What differences might be contrasted between educators who were experienced in bilingual education and those who were not?

This paper presents the results from an initial stratified random survey of K-12 professional educators (N=755) of where 113 were certified and teaching in bilingual classroom environments. The data collection instrument was self-disclosing by respondent. First, to establish an initial priority ordering, each respondent selected 20 of the available 52 statements as perceived requirements for a comprehensive policy on computing ethics and equity. Second, to simulate an artificial environment of imposed general (viz. undefined) constraints, each respondent selected the top-10 of these initial 20 components.

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ANALYSIS

Differences in policy priority perception were analyzed statistically utilizing contingency table analysis and the chi-squared statistic. Because of the stability of the standardized adjusted residual (± 2.0), a significance level of $p \leq .1$ was considered acceptable *a priori*.

FINDINGS

Exclusively bilingual educators were contrasted with exclusively monolingual educators, resulting in 13 perceptual differences related to policy issues of curriculum, access, privacy, teacher and student needs, community roles, and software and hardware resources. A 60% increase in these differences occurred when artificial constraints were introduced. Bilingual educators initially differed from their monolingual classroom colleagues in issues related to curriculum, access, teacher needs, and software demands. When artificial constraints were imposed, these differences increased to include privacy and community considerations. (Refer to Table 1.)

DISCUSSION

Unconstrained Policy Development

Three (3) unconstrained priorities were found to be related to the background demography of the bilingual educator:

01 Strive towards integrating use of the computer, where appropriate, at all levels and throughout the curriculum.

02 Strive to see that all students have equal access to computers and computer related experiences. I will see that students have such access no matter what their academic potential, ethnicity, gender, socio-economic group, or special education status.

03 Give attention to teaching students the ethics of computer use.

Similarly, two (2) priorities were found, when policy priority selection was unconstrained, to be related to the background demography of the monolingual educator:

01 Evaluate the type of computer instruction being given and to whom it is being given. The evaluation will examine planned and unplanned outcomes, including changes in the roles of teachers, students and administrators.

02 Evaluate software in the light of the needs of prospective users and the goals of school and community.

Constrained Policy Development

Four (4) constrained priorities were found to be related to the demographic background of the bilingual educator:

01 Strive to see that all students have equal access to computers and computer related experiences. I will see that students have such access no matter what their academic potential, ethnicity, gender, socio-economic group, or special education status.

02 Help teachers keep up with current trends, research and literature related to computer developments affecting education and the curricular implications of these developments.

03 Provide training to members of the educational or general community when asked and when practical in order to encourage parental involvement in long-term planning of computer use.

04 Allow for cooperative participation of teachers and administration in the selection of equipment.

Lastly, four (4) priorities were found, when policy priority selection was constrained, to be related to the demographic background of the monolingual educator:

01 Evaluate the type of computer instruction being given and to whom it is being given. The evaluation will examine planned and unplanned outcomes, including changes in the roles of teachers, students and administrators.

02 Teach to those I supervise the legal and social responsibilities that attend collecting, manipulating, and disclosing data--in school and in society.

03 Participate in evaluation of results of educational computer use.

04 Evaluate software in the light of the needs of prospective users and the goals of school and community.

RELATED FINDINGS

Bilingual educators who taught exclusively in a bilingual environment also differed from those bilingual teachers who had mixed-assignments of monolingual and bilingual instructional periods. In these instances exclusively bilingual teachers perceived significantly different policy initiatives in the areas of both student needs and hardware resources when artificial constaints were introduced.

Table 1. Summary of unconstrained and constrained policy priorities based upon a bilingual education disciplinary focus.

Unconstrained Policy Development

Priorities related to preferences of bilingual educators

- INTEG COMP USE AT ALL CURR LEV (comprehensive curricular integration)
- USE EQUITY VS STUD STATUS/NEED (equity among student users)
- TRNG APPROP TO CLSRM COMPU USE (pre-utilization training)

Priorities related to preferences of monolingual educators

- EVAL CAI TYPE AND TO WHOM GIVN (strategic planning and evaluation)
- EVAL VIA USE/SCHL/COMMUN GOALS (program validation)

Constrained Policy Development

Priorities related to preferences of bilingual educators

- USE EQUITY VS STUD STATUS/NEED (equity among student users)
- UNDERS COMPU DEV / CURR IMPLIC (intra-education literacy)
- PRNT INVL IN COMP STRATEG PLNG (participatory planning)
- TCH/ADM PARTIC IN EQUIP SELECT (participatory selection)

Priorities related to preferences of monolingual educators

- EVAL CAI TYPE AND TO WHOM GIVN (strategic planning and evaluation)
- TCH SUBORDS DATA USE RESPONSIB (staff inservice development)
- PARTIC IN EVAL COMPU USE RESLT (participatory evaluation)
- EVAL VIA USE/SCHL/COMMUN GOALS (program validation)

No. 1 - A CHANCE FOR EXCELLENCE: BUT CAN WE EDUCATE THE EDUCATORS

Presenter: Don Stewart*

1.0 - Introduction

There is no other aspect of human life in these United States which is as important as education. Almost everyone in this country spends from 10 - 20 years of his/her life in a school situation and the effectiveness or ineffectiveness of that educational experience affects not only the students, but those people who will associate with the students and ultimately all of society.

1.1 - Current Status of Education

In our high schools, approximately one million students every year or 3,000 students every day are becoming dropouts and are being pushed out to become a burden on our social service systems such as unemployment; welfare; remedial training; and through crime, many of these dropouts will end up in our prisons; etc.

In our colleges and universities, over a million of our "*cream of the crop*" students every year or 4,000 of these students every day are being pushed out as higher education dropouts. The disappointment and frustrations of not being able to reach their potential decreases their potential contribution to our country and makes them less effective on the job and even decreases their interest in becoming "*good citizens*".

Even those students who are able to graduate from high school and from a college or university are only taking with them a mediocre education in which the majority of the graduates are "C" students and they have **NOT** learned 20 - 30 percent of what their teachers thought was important for them to learn.

1.2 - The "*University Teaching Model*" (UTM)

The most influential model of education is the "University Teaching Model" (UTM). The key goals of the UTM should be familiar to everyone who has been through a college or a university. The goals are to have complete academic freedom, to teach the fewest classes possible, to teach the fewest students possible, to have as much free time as possible to do research (in order to publish), to get promoted up the UTM career ladder(which depends on the quantity of articles and books published) and, of course, to get more money for each of these goals.

The key characteristics of the UTM are that the faculty do not want to be held responsible for motivating students to be interested in their subject matter areas, they want student learning or student failure to be the students' responsibility, any evaluation methods and criteria used by the faculty are to be determined only by the faculty member, the content actually presented in their courses is up to the faculty member regardless of the implied content suggested by the course title or catalogue descriptions, faculty should not be required to know anything about their students, faculty are not expected to help solve any of their students' learning problems, they should be free to use any instructional method they wanted to and their teaching efforts should not be supervised by anyone.

The key concept to remember is that although all faculty in higher education can be considered to be "*professionals*" in their special subject matter areas, very few, if any of the faculty can be considered to be "**Professionals**" in designed Instructional Excellence. This is because very few of them have had any special training in "*how to teach*", in "*how to test*" and in "*how to help students be successful in learning*".

2.0 - Where Are The Current Reform Efforts Taking Us?

During the past five years, a number of research studies by individuals, groups, universities and state and national commissions have released a number of reports and books on the status and conditions of education along with their recommendations for necessary changes. The common thread among all of these publications is that our educational system is in trouble. Their recommendations for change are varied, but there is also a pattern to these suggestions and the pattern has become the basis for the many educational reforms which have been enacted in states throughout the country.

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(For more information, visit the ICAT/SLATE booth in the exhibit area)

2.1 - Traditional Assumptions Which Have Had Negative "Affects" on Education

The most negative of the traditional assumptions has been that in the average classroom the teachers' expectations are that there will be a "***normal***" curve of learning based on the "***abilities***" of the students.

2.1.1 - Capacity vs. Ability

This is in part because traditional educators confuse the concept of "***capacity***" with the concept of "***ability***" in that they accept (***by their actions***) that students' abilities are limited like a one gallon container that can only hold one gallon and no more. These are two very different concepts and should not be confused. Although "***capacity***" does refer to limits, "***ability***" is a concept without limits and can be very much affected by training.

Which brings up the debate over "***nature***" vs. "***nurture***" which has been going on for decades and even centuries. The key to the debate should not be that it has to be one way or the other, but that they work together. What "***nature***" doesn't provide, "***nurture***" can develop through training, study and practice. It is currently accepted by most educators (***at least in theory***) that **all students are capable of learning successfully**. The problem is that very few educators put their belief into practice.

2.1.2 - Coleman Report

In 1966, J. S. Coleman and others released a report called "**Equality of Educational Opportunity**". In this report, Coleman stated that most of the affects on student learning can be traced to factors external to the classroom: student ability, home and community environment, parent involvement, etc. It was also suggested that teachers and schools only have a minimal affect on student learning.

Obviously, this report gave strong support to those traditional educators who wanted to believe in the "***nature***" part of the debate so that they wouldn't feel any guilt when students failed and were not successful in their classrooms. Many researchers and teachers have quoted Coleman's report to explain high student dropout rates and the students' lack of success in schools

If it is true (***according to Coleman***) that the external environment has more affect on student learning than the schools and teachers, then the traditional educators feel justified in asking for reforms which will benefit the teachers because, after all, there is nothing that teachers can do to affect the external environment.

However, the key in reading the Coleman report is that it is the current traditional role of the teacher that has a minimal affect on student learning. This does not mean that if the teachers were to change their role to a more effective role that they couldn't be much more successful in affecting student learning. Using the truly **Professional** teacher's role and **Instructional Excellence,** they can have dramatic affects on student learning in their classrooms.

2.2 - A Quick Review of Current Reforms

Almost all of the educational reforms enacted and proposed during the last five years have been directed towards school requirements, teachers, teacher preparation and student requirements.

2.2.1 - For Schools

The main reforms affecting schools concerned the time that school were to be in session. Some states and school districts have increased the number of days schools operate and in some cases, the number of hours per day that the schools are to be operating.The concept of parents' "*choice*" of their children's schools is spreading. A key part of the concept is that the funding follows the students and is supposed to encourage the schools to improve. The "*choice*" concept also assumes that the schools already know how to improve and are just waiting for the right motivation.

2.2.2 - For Teachers

The biggest reform affecting teachers has been their salary increases around the country. Probably the vast majority of teachers have received 20 - 30 percent increases. In Rochester, N. Y., teacher salaries have almost doubled. In addition, there has been some attempts to reduce the class sizes, to decrease the number of classes a teacher has to teach and now the big thing is to get more teacher involvement in school decision-making. There has also been various attempts to set up career ladders and merit pay proposals, but these have not been very wide spread.

2.2.3 - For Teacher Preparation

The primary problem was thought to be that they needed to attract better teachers to teach in the schools. The first step was to increase the standards for accepting students in teacher training programs. There has also been an effort to increase the emphasis on subject matter competence and a de-emphasis on the need for teacher training. Another step was to set up alternative programs where people interested in becoming teachers could become teachers with a minimum, if any, teacher training type courses.

There has also been an increased effort to identify what should be included in a teacher preparation program. The problem is that the traditional educator's role is to present course content. However, teachers throughout higher education carry out their presenting role with no teacher training at all. In addition, educational research has not been able to prove that anyone needs teacher training in order to get a "*normal*" curve's worth of student learning.

2.2.4 - For Students

The main reforms for students have concerned increased standards of required courses for graduation and increased testing at different grade levels. Some states have increased attendance requirements, disciplinary standards and the use of the "*No Pass/No Play*" concept. There has also been an increase of "*choice*" programs (*magnet and alternative programs*) and some increase in the use of technology.

2.3 - How About the Results of the Reforms

The results, so far, have been rather lopsided. The only measurable results have mainly been in reference to benefits for teachers. There has been a minimum increase in student learning on standardized tests primarily because of the added required subjects and not because of any changes occurring in the teaching/learning event in the classrooms.

2.3.1 - For Teachers

In general, teacher groups in elementary and secondary schools around the country are continuing to ask for more of the "*same*" (*UTM goals - increased salaries, smaller classes, fewer classes and greater involvement in school decision-making*). Of interest is that this direction has already been tried. In higher education, the faculty certainly represent the best available subject matter experts, they have the smallest classes on average (*although some freshman classes are quite large*), they also teach the fewest classes and have the greatest control over their classes and over the school environment.

These "*cream of the crop*" faculty working under "*cream of the crop*" conditions and with "*cream of the crop*" students have managed to achieve lower levels of mediocrity (*less than "normal" curve achievement*) and greater levels of dropouts than most innercity secondary schools! (*Obviously, the UTM must NOT be the right direction or model for education.*)

What has happened with technology in the classroom? As most of the people at this conference should know, educational technology is still supposed to be only used as a "*supplement*" to the teacher. Almost all technology vendors still tread on "*eggs*" when they reassure teachers that their technology "*will not replace the teacher*". Even in the most recent study by the Office of Technology Assessment, "Power On", it states that

> *"Educational technologies are not self-implementing,*
> *and they do not replace the teacher."*

2.3.2 - For Students

In the classrooms across the country, it is typically "*business as usual*". Not much has changed to help students become more successful in the teaching/learning event

However, for the disadvantaged minorities, the increased standards of more academic courses, increased standards of achievement and increased entry requirements for higher education have had negative affects on the disadvantaged students. There will be more and more of these students dropping out of school and there will be fewer and fewer of these students becoming teachers!

2.3.3 - For the Taxpayers

Taxpayers across the country have accepted the increased costs of education based on the hope that more students will be learning more and that there will be decreased negative affects of the current traditional educational **mal**-practices. Almost every benefit for the teachers costs the taxpayers more, but the taxpayers are not getting the results they were promised.

3.0 - The Potential of Instructional Excellence

There is a possibility for significant gains in student learning. The concepts are not really new. I wrote my first paper on **Instructional Excellence** and the need for **individualized instruction** in 1963. Most educators have known about the benefits of **individualized instruction** for over 20 years.

3.1 - Instructional Excellence Has a New Role For the Teacher

Most of us who have been in instructional technology have talked about the role of the teacher who no longer presents the course content because that is done by the technology. The real **Professional** teachers spend most of their time diagnosing student learning problems, solving those problems and prescribing solutions to those problems. We all know that this is the role of the teacher that will truly make a difference in student learning.Under the parents' "*choice*" plan, if the funding follows the student to the school of "*choice*", why not let the funding follow the student to the "*teacher of choice*" even in the same school. In this way, teachers who can teach more students with no loss of Instructional Excellence will also earn more money!

3.2 - Instructional Excellence Has a New Role For Technology

The instructional technology should be designed to take over the traditional "*presenting*" role of the teacher and in **replacing** the teachers' traditional role, technology releases the teachers to perform the much more important **Professional** role.

3.3 - Instructional Excellence Also Has a New Success Role For the Students

As a country, we all have a responsibility to the students in our schools at all levels of education. We need more competent workers. We do not need more citizens who are illiterate, functional illiterates or with a mediocre education. What our country needs is **Instructional Excellence** for all students!

3.3.1 - This Consists of Individualized Instruction

If we really believe that students learn best at different rates and learn best from different methods and materials, then **isn't it about time we put our actions where our beliefs and our mouths are!**

3.3.2 - This Also Includes Quality Controlled Learning (Zero Defect)

Remember, it is not enough to just **individualize instruction**. In accordance with many research studies, the technology that will be replacing the teachers' presentations will at least result in the same mediocre student achievement of the traditional educators. **Quality Control** in student learning will be achieved through the efforts of the new **Professional** teachers who will be solving student learning problems such that 90 percent or more of the students will be achieving 100 percent of their unit and course objectives.

Instructional Excellence can be achieved by a partnership of technology and the new Professional teachers!

LOTHIAN REGION / BRITISH TELECOM NETWORKING PROJECT

W. D. C. Semple *

ABSTRACT

The dual application of powerful microcomputers and modern telecommunication systems offers exciting educational possibilities. In the UK a national telecommunications company, British Telecom, has supported a joint project with a local education authority to explore some of the technical and educational factors involved.

INTRODUCTION

Lothian Region, bordered to the north by the Firth of Forth and to the south by the Southern Uplands, is one of the smallest regions in Scotland by area but has the second highest population with almost 750,000 people. It extends from the old industrial areas of West Lothian and Midlothian to the rich farming country of East Lothian with the city of Edinburgh, Scotland's Capital, occupying a strategic central position.

As the local education authority, Lothian Regional Council has the prime responsibility for providing the Region's educational needs. The Department of Education is the major service department with a current budget in excess of £220 million ($385 million) and responsibility for a school population of almost 100,000 students.

The 51 secondary schools each have an average of around 35 microcomputers. These are, typically, organised into two computer laboratories with 12 workstations in each with the remainder spread across other departments. The laboratories are run by Computer Studies departments but are generally available for use by other departments. Until recently the BBC microcomputer, manufactured by Acorn Computers Ltd, dominated but now the Apple Macintosh (usually called the 'Mac') has grown in numbers to the point where many schools now have established a lab of these computers. Both types of computer are normally organised in Local Area Networks - 'Econet' in the case of BBC micros and 'AppleTalk' in the case of Macs. The two computer systems are incompatible with each other.

THE EDUCATIONAL USE OF COMMUNICATION SYSTEMS

Currently, most schools have a single telephone line designated for data communication use. In 1988 the UK government provided a grant of £100 ($175) per secondary school for this purpose. This line allows access to the national and international packet switchstream system (PPS and IPPS) but has a number of disadvantages. It only allows one access at any time, it incurs local telephone call charges when accessing the nearest PPS node and it is limited in its speed and functionality by the sometimes noisy telephone voice lines.

A wide range of educational opportunities already exist in the UK for communication systems and the applications are growing rapidly. The following are only some.

Electronic Mail and other on-line information services are compulsory topics of study in a number of courses currently offered in Scottish schools: Standard Grade Computing Studies, Standard Grade Office and Information Studies, Higher Grade Computing Studies (Communications Option) and a number of short courses. Equally important are the enormous benefits that students can gain by communicating with others locally, nationally and internationally.

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A large number of on-line databases provide a variety of educational information for both teachers and students. The following is only a sample.

The **Educational Counselling and Credit Transfer Information System** is a database of all advanced and non-advanced further and higher education courses in the UK. Searches can be made on a variety of criteria and it is of particular interest to careers staff in schools but could also be used by pupils themselves to browse through course possibilities.

Signposts is a jobs database providing up-to-date information about type of work, qualifications and aptitudes required, contacts and addresses.

The **Special Educational Needs Database** is a database of information to help those involved in supporting children with Special Educational Needs. It provides information on contacts, courses, conferences, hardware and software. Searches can be made using a number of criteria such as disability type, computer type, etc.

The **National Educational Resources Information Service** contains information on an enormous variety of educational resources such as books, worksheets, reports, software, training packages, etc. Again searches can be made on a variety of criteria and many items can be downloaded into the school computer and printed out for use in the classroom.

Many new and exciting educational possibilities arising from communication systems are, as yet, unexploited in the secondary school sector. The concept of cooperative working with students on other sites and even in other countries as well as the possibility of young people organising their own teleconferencing on topics of mutual interest are two examples of possible developments in this field.

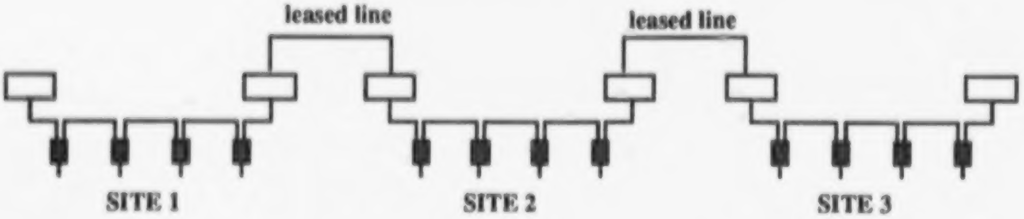
What is needed is a communication system which allows existing on-line facilities to be more readily available, but also one which makes these new possibilities attainable. Rather than allow one on-line access at any one time, the ultimate goal is to create a system whereby any workstation in one school can communicate with any workstation in another, anywhere in the world.

These issues were known to both the Scottish Council for Education Technology and the Scottish Education Department. The two groups had been in discussion with British Telecom in an attempt to bring industrial expertise to bear on these and related problems. From these discussions a practical project between Lothian Region and British Telecom has evolved which will last for one year and will be funded by British Telecom.

TECHNICAL CONSIDERATIONS

To keep the project manageable three sites were chosen, two secondary schools and a teachers' resource centre. Different ways of interconnecting the sites were initially discussed. For example the use of 'leased lines' could have provided fixed links (Fig 1).

Fig 1. Possible connection of sites using leased lines

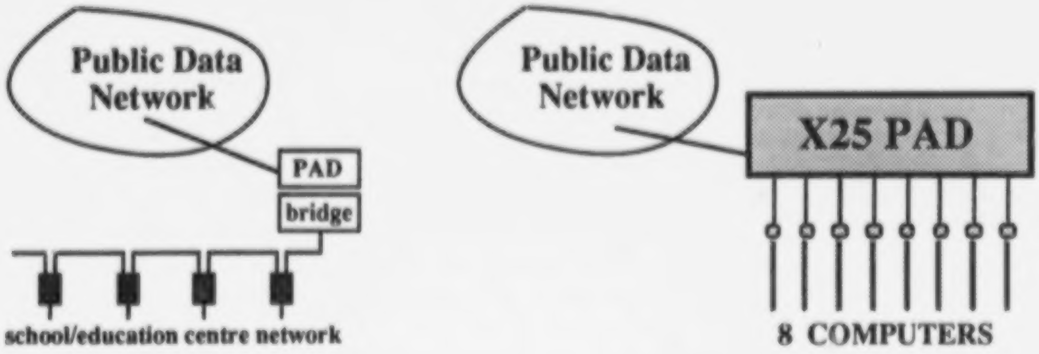


This had advantages, but was rejected in favour of linking each site directly into the Public Data Network (PSS). The international protocol (X25) for such a connection has been established, but unfortunately no X25 gateway existed for the computers involved. This meant that an X25 PAD (Packet Assembler Disassembler) had to be installed on each site.

The PADs available through BT normally had built in multiplexors with up to 8 logical channels. This offered two methods of connecting a number of computers to the data network (Fig 2):

(a) by using a network ***bridge*** and only one of the ports; or
(b) by direct connection of up to eight computers to the PAD.

Fig 2. Methods of linking into the Public Data Network.

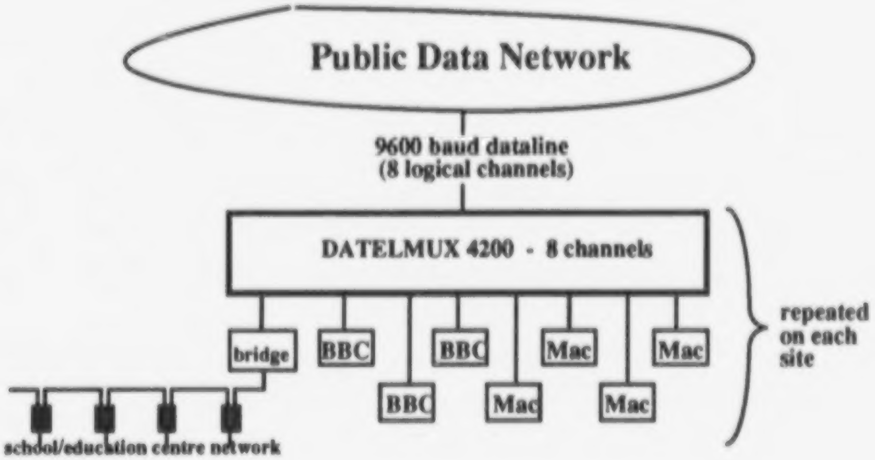

Public Data Network
PAD
bridge
school/education centre network
Public Data Network
X25 PAD
8 COMPUTERS

(a) using a network bridge ***(b) using the PAD's multiplexor***

Since each method had its merits, the evaluation of the method that provided the best educational solution was included in the project objectives. Also, each channel port provided the universal RS-232 protocol and so a variety of different computers could be connected at the same time. This meant that data interchange could, to a large extent, be independent of the type of computer in use at any particular site.

At the time of preparing this paper (December 1988) the equipment had just been installed at each of the three sites, as indicated in Fig 3. This particular system enables the equipment connected to the ports to be changed from day to day or even period to period to meet the needs of particular lessons.

Fig 3. Typical systems arrangement at three sites.


Public Data Network
9600 baud dataline
(8 logical channels)
DATELMUX 4200 - 8 channels
bridge
BBC
BBC
BBC
Mac
Mac
Mac
Mac
Mac
repeated on each site
school/education centre network

EDUCATIONAL OUTCOMES

The educational aims of the project are summarised below:-

Courses in Schools about Information Services
At the moment schools have, at best, one telephone point available when teaching students about Electronic Mail or On-Line Information Systems. This may permit a demonstration by the teacher but make hands-on practice for students almost impossible. The proposed system will mean that 8 computers can be simultaneously connected to such services allowing classes of students to gain first hand experience of these systems.

Courses in Schools about Communication Systems
New courses such as Higher Grade Computing Studies have topics which examine communications systems in detail from the user viewpoint down to the actual communications protocols and concepts such as *packet switching*. The proposed equipment will transform theoretical lessons into real practical experiences for students. They will be able to see, at first hand, processes of packet assembly and disassembly.

In-Service Courses at Teachers' Centre
In-service training courses on the use of on-line systems are provided for teachers, librarians and resources officers. It is currently very difficult to provide practical experience at such courses because only one, or possibly two, telephone lines are normally available. The proposed equipment will mean that eight lines can be used simultaneously to access such services.

Downloading Local Resources to Schools
Local area network bridges will make it possible for teachers to gain access to the network at the Education Centre or even to link their own network to it. This will allow schools to download software, documentation, information and other resource materials efficiently by electronic means.

Language Development Opportunities
The 8 ports provide a direct gateway not only to services available through PSS but also the full international system. The project opens up opportunities for electronic exchange between children in the two pilot schools, but also permits communications with children in other countries. This can extend beyond the exchange of text, pictures and diagrams. Software packages like "Timbuktu" make it possible for students to work cooperatively on the same document even if they are on different sites.

Facility for School Libraries and Resource Centres
When not being used for teaching classes some of the eight lines can be switched to the school resource centre so that librarians or teachers can make enquiries about resources, or students / career's teachers can enquire about course or career opportunities.

Local On-Line Facilities
Currently, Lothian is experimenting with its own on-line databases. One example allows pupils aged 16 to explore possibilities for jobs, courses and training schemes within the Region. These trial databases are, at the moment, available on a single dial-up telephone line. The proposed project will enable these to be made available through PSS and will allow a number of simultaneous enquiries.

CONCLUSION

Although the project is still at an early stage of development, initial indications suggest that it should considerably enhance the educational opportunities for students, while providing wider access to a range of databases for both students and staff. The results could provide a guide for future educational communication systems across the whole country.

INTERNATIONAL RESEARCH IN DISTANCE LEARNING: PROBLEMS AND PRIORITIES

M.S. McIsaac*

ABSTRACT

This presentation examines the growing interest in international research on distance learning and discusses the difficulties encountered both in locating existing research studies and in conducting original research. Two projects directed toward locating research studies are described. The first is the documentation resource database at the United Nations University International Centre for Distance Learning. The second is a research study which explores one method for quantitatively synthesizing existing research in this field. The second part of the paper explores difficulties encountered in conducting original research internationally. Problems and priorities are discussed from the point of view of the economic, political and social climate for research. Recommendations are made to first synthesize existing research and then to conduct programmatic study in those areas which appear to be of greatest interest to distance educators; cost effectiveness, student motivation and learning, and persistence of study.

INTRODUCTION

Interest in the field of distance learning is accelerating rapidly with the development of new communication technologies. In many cases educators are faced with problems as they search for solutions to meet their particular needs. Often studies are conducted quickly at the request of administrators or politicians to determine needs assessment or provide cost benefit analyses. Both locating existing research and conducting original research in this rapidly developing field can present problems.

There is a lack of information about international distance learning research, particularly in developing countries. Although there are a number of studies which are done in Eastern Europe, Asia, Africa and South America, many are not reported in international journals. Often these studies are done at the request of the government or of an international funding agency. In many cases problems are encountered in data collection and analysis. Then, although a significant amount of resources often go into these projects, results which could benefit countries with similar problems are not generally available to the international community.

Large scale research in distance learning has been conducted primarily by countries in Europe, North America and Australia. Research needs have been

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defined and research agendas have beeen undertaken by countries such as Canada (ref.1). Since 1980, many developing countries have begun their own distance learning programs to educate people in rural areas and to raise the literacy rate. Using Western distance learning institutions as models, countries such as India, Indonesia, Tanzania (ref.2) and Turkey (ref.3) have instituted massive programs, often in a very short amount of time. In many of these situations, model distance learning universities such as the British Open University or the German Fernuniversitat have provided guidelines. However, the political and economic situations of developing countries are often so dissimilar as to prohibit mass importation of such programs. In many instances, original research must be done to determine the most cost effective solution for a country's unique educational problems.

LOCATING RESEARCH

The first problem encountered is locating existing research. Although there are a number of journals such as Distance Education, (Australia), The American Journal of Distance Education (USA), Journal of Distance Education (Canada) and ICDE Bulletin (UK) which report research , many describe programs rather than report empirical studies. In some cases research is conducted using government or agency funds and the results become proprietary and are not reported in journals for general circulation. In other cases studies are of the one-shot variety and lack the rigor needed to be generalizeable. The descriptive reports are of interest to people in similar situations who need models as guidelines. However, the time is right to begin to use descriptive reports to formulate testable hypotheses. In fact, we are now beginning to see the emergence of serious research questions in the areas of organizational policy, learner characteristics, curricular issues, and underlying theory (ref. 4).

Two solutions are suggested for locating and consolidating available research in this area. First, increased support should be given to the primary documentation and retrieval center for literature on distance learning; the Open University International Documentation Centre located at the Open University in the UK. This centre, under the direction of Keith Harry, collects materials and produces regular accession lists of publications received (ref.5). Increased cooperation from the community of distance learning scholars conducting research around the world could help to make research studies more accessible. Second, a synthesis of research being done worldwide in distance learning should be given high priority. One such study is being conducted at Arizona State University to quantitatively synthesize current research using a meta-analytic method . In this initial study three major distance education journals, Distance Education, The American Journal of Distance Education and ICDE Bulletin were searched. In addition the literature in Dissertations Abstracts, Eric Documents, and recent documents from the International Documentation Centre were analyzed in order to define categories which are currently of importance to researchers internationally in distance learning. The categories of note which emerged were cost effectiveness, student motivation and learning, and persistence of study. Approximately 20 studies which provided the necessary statistical information to compute effect sizes were selected for the meta-analysis (ref.6). This pilot study marks simply the beginning. Further work is needed to locate, replicate and systematically conduct research on those topics useful to distance educators throughout the world.

ORIGINAL RESEARCH

In order to advance the applicability of research to practice, international distance educators must be able to not only locate studies done by others, but conduct original research to answer their own particular needs. Both priorities established and problems encountered in conducting original research can be considered from three perspectives. Research projects must take these priorities into consideration if problems are to be avoided.

Priorities for conducting research.

1. Economic--The most important consideration for the majority of developing countries is ecomonic independence. It is in many of these countries that the largest distance learning projects are taking place. A top research priority is to improve the cost effectiveness of education and to provide training and jobs for the general population.
2. Political--The goal of education, particuclarly in developing countries, is to support the political organization of the country and to develop good citizens. Research projects which endorse this priority will have greater success.
3. Social--Some governments seek to promote the cultural and social status quo to be reflected in their educational programs. For many there is also the desire to provide equality of educational opportunities for all. Researchers and distance learning administrators must analyze the social climate of the country and incorporate those priorities into any program for it to be successful.

Problems in conducting research.

1. Economic--There is often a perceived lack of financial resources for conducting research, particularly prior to embarking on a massive distance education plan. In many cases investing money in research is seen as unnecesssary and a drain from areas in which the money is needed. An existing plan from another country is often used and revised where needed.
2. Political--There is an observable trend toward self-determination both in setting up distance learning programs and in conducting research. Although outside experts from the Western world are consulted, developing nations prefer to train their own experts and conduct their own research. There is a preference for locally initiated and conducted research as can be seen by examining bibliographies and references.
3. Social--Although local expertise is preferred, there is frequently the problem of locating qualified researchers. In many cases profesionals in developing countries have been educated abroad, but once they return home they have little opportunity for using and later updating their skills. In situations where consultants are used, care must be taken to consider social and cultural constraints in initiating and reporting research.

CONCLUSIONS

Research in distance education is still in its youth. Reports from the first American Symposium on Research in Distance Education in 1988 indicate that questions are still being formulated as to what types of research need to be done. Numerous studies have been conducted regarding organization and administration, and course content. Some of these studies are descriptive and non-generalizeable. However, we are beginning to see increasing concern with cognitive aspects of distance learning, and longitudinal studies which examine long term effects. In his reveiw of research in distance education, Holmberg (ref.7) states that a research discipline has, indeed, emerged in this field. Many of our colleagues from developing countries are involved on a large scale with developing distance learning programs. By paying attention to the problems and priorities inherent in conducting international research we may begin to join forces to develop consistent methods for evaluating results which will benefit the entire field of distance education.

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OAKLAND-TROITSK STUDENT EXCHANGE

P Hutcher

ABSTRACT

Project Summary: Last July, 23 students, grades 5-8 from Oakland, CA spent 3 weeks at a computer camp in Troitsk, a small city outside of Moscow, USSR. In December of this year anequivalent student group from Troitsk will pay a return visit to Oakland. Both visits will encompass a wide variety of computer and cultural activities.

In between visits, students from both cities continue to communicate and carry out joint curriculum projects by means of Telecommunications.

The exchange will be ongoing, with one or two visits per year from each city. Future themes will vary, but will continue the use of computer and telecommunications technolgy as a core.

We will present slides and videos from the Soviet and American portions of the exchange and explain what we view as the educational and technological significance of the project.

Certification: I hereby certify that this is a project of the Oakland Unified School District, and is a non-commercial venture.

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THE GROWTH OF ENGLISH AS THE LANGUAGE OF INTERNATIONAL TELECOMMUNICATIONS: ISSUES AND IMPLICATIONS FOR EDUCATION

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ABSTRACT

English has become the dominant language of international tele-communications, including most international computer uses, based in part on its increasing roles as the major "universal" language, especially in science and technology. It has gained widespread acceptance as the primary "link language" in the world today, no longer tied predominately to native speakers. As such, it is in the process of denationalization which is possible because message content and language structure can be and are being separated. English can thus be used as the linguistic medium of development, much of which is accomplished via telecommunications technology, in Lesser Developed Countries without their sacrificing indigenous cultures and languages. English can best be viewed as a tool for the attainment of higher levels of development and education in many LDCs.

According to Pelton (ref 1), what he calls the world of "global talk and global think" is arriving, so much so that international telecommunications which play a major role in creating this world are having enormous influence on aspects of life such as cultural differences and language barriers. This influence on culture and language worldwide is not just from the content of the communications themselves, such as television programs, films, cables, banking data, etc., or the communications medium whether it be computers, satellite delivery, fiber optic cables, or some other aspect of the integrated grid. There is another influence -- the language most commonly used in global telecommunications -- English. Strevens (ref 2) noted "As the telecommunications revolution got under way, English became dominant in the international media, radio and TV, magazines and newspapers....so, too...[in] space science and computing technology."

For we technologists and educators, people involved in the intersection of telecommunications technologies with education at an international level, an understanding of the import of the use of English is crucial, as part of others' responses to us will be on the basis of their attitudes toward the worldwide hegemony of English. First, English is widely recognized as a major international language, in fact the primary "link language" in the world today and no longer tied mostly to native speakers of the language. For example, it's not uncommon for a company to be, say, Tokyo-based, with plants throughout Southeast Asia and offices in the United States, Latin America and Europe, to use English as the common language for communication within that company.

This not at all unusual example illustrates another important fact about the use of English today. The number of non-native speakers is estimated to be far greater than those who speak it natively. Native speakers are commonly figured to be around 300 million, while non-native speakers have

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estimated to be as high as 1.5 billion. What brought about this apparently unique situation that English finds itself in, that Russian, Japanese, French, Abrabic, Swahili, Mandarin Chinese, and Latin don't or never did? First, there was the British empire which began the spread of English worldwide. Then after the sun began to set on the empire, American multinational corporations continued the spread. Further, companies such as IBM and Tandy have been instrumental in creating an association between English, science and technology. They also train foreign nationals who work for them abroad in English, as the corporate language is English. But their presence in the spread of English is even more pervasive in that the manuals and technical instructions accompanying their computers are in English. So even in Quebec which can be militantly francophone, French speaking technicians use English computer manuals. Furthermore, many Quebecois play computer games -- in English.

Further, English is often thought of by many non-native speakers as a language in which to get things done, e.g. the language of development which flows from scientific discoveries and the use of technology. Thus it is used as the major link language for development and is the language carried via power technology forms -- telecommunications and computers -- which are considered to play a crucial role in development. What might this language dominance in both the production and use of these technologies mean for people in so-called Third World or Lesser Developed Countries (LDCs) who desire to develop, educationally as well as technically, yet who often wish to maintain local languages and cultures?

Posing any satisfactory answer to this question is far beyond the scope of these four pages, as language matters are characterized by massive complexity -- and that is a gross understatement. It has been suggested that human beings cannot even begin to imagine the complexity of language, let alone address it. However, as a linguist, I'm bound to try and can offer insights into understanding the impact of English on education and development in LDCs. First, it is widely acknowledged that English is in the process of denationalization. In other words, it is no longer tied most directly to the cultures and nations which use it as a native language. Kachru, an Indian linguist, contends that LDCs often use English to "teach and maintain the indigenous patterns of life and culture, to provide a link in culturally and linguistically pluralistic societies, and to maintain a continuity and uniformity in educational, administrative and legal systems" (ref 3). So it even has a local use, an intranational use in some cases, as well as an international use.

Why was it possible for English to gain this status? Baxter says it well. "The use of English is always culture-bound, but the English language is not bound to any specific culture or political system" (ref 4). In other words, a language's structure is more neutral than not, able to act more like a window in allowing communication to pass through it, if you will, rather than necessarily distorting the message with overtones of U.S. or British culture. So while the content of much educational material transported via telecommunications or via computer software may be culturally bound, English itself is not inextricably part of the cultural message.

The "reality" of separation of language from content is crucial for educators to understand, both by those in English-speaking countries who create most of the technologically advanced educational materials using telecommunications and computers, and by educators in the LDCs who desire educational advancement for people in their countries, as well as development, but who otherwise might reject such materials as being inimical to the survival of indigenous languages and cultures, which many in LDCs are worried about preserving. Krishnaswamy and Aziz put this apparent dilemna well when they stated "Without losing their valuable values and cultural heritage, people want better relationships. They want to be Indians/Arabs/Japanese/Chinese etc. and at the same time international" (ref 5). But if we separate the two, as we can, people do not have to reject powerful technologies which can enable development -- including higher levels of education necessary to support development -- because they are associated with English, a language sometimes called "a pawn of American imperialist designs."

In order to understand this tension better, however, it is instructive to understand something about what development is. For one, it is products and includes computers, radios, TVs, tape recorders, satellite dishes and other information technology forms. It has also been defined as "the doctrine of organized universal betterment" (ref 6). And English is widely viewed internationally as the language of development. As nonsensical as that connection maybe is, in the sense that English is in no way inherently better able to express technological thoughts than other languages, it does have a "muscular" technological vocabulary already in place and constantly growing, which enables its users to communicate about the products of development, the technology of development, the role of education in development, and how education and technology strengthen one another. There are many languages in the world in which this is simply not possible at the present time.

Given these serious issues raised by the status of English as a world language, the hegemony of global telecommunications over the world's information structure plus their importance in development and educational growth, and the role of English in telecommunications, what is its possible future in LDCs? As both educators and communications technologists, we have a stake in understanding the possible answers to this question. As a whole, linguists, including myself, feel that English will probably continue to spread as a link language. Research indicates that many users in LDCs feel the same, that its use will continue to spread among non-native speakers. Thus English will probably continue to be denationalized, belonging more and more to those who use it for linking purposes, for transnational communications, for educational use possibly within their own countries, and for technology. Unless, of course, simultaneous machine translation becomes a reality soon. In that case, if such translation were to become widespread enough in use, one could foresee people not wanting to put in that time needed to learn another language. However, I suspect that won't happen anywhere in the near future, as we don't yet know enough about language to reliably program a computer with any sophistication, nor are the computers "smart" enough at this point to allow for relatively simple natural language comprehension and production programs.

I think it fair to characterize English as, at best, a tool for the attainment of higher levels of development and education which can definitely be in the public interest to use as a link language at this time in history. In a very real sense, English is a window on the world. It's useful in some domains such as technology, including telecommunications technology, which is involved deeply in modernization efforts. And the data show that liking and usefulness are not connected. You don't have to "love" native speakers of English to find the language useful. Wardhaugh (ref 7) sums it up well:

> English is the least localized of all the languages of the world today. Spoken almost everywhere in the world to some degree, and tied to no particular social, political, economic, or religious system, nor to a specific racial or cultural group, English belongs to everyone or to no one, or it at least is quite often regarded as having this property.

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COMPUTER-BASED COMMUNICATION BETWEEN SCHOOLS AND HOMES

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ABSTRACT

A system has been developed that gives teachers and school administrators quick and easy communication with parents of students in a school. The program, known as Compu-Call (note 1), stores natural-voice messages and uses a data-based file management program to place calls to selected homes at specific times. The system also includes a positive attendance monitoring and management program which automatically contacts parents when a student is not at school, and arranges for meetings with parents when absenteeism becomes excessive.

welcome to
COMPU-CALL
Please enter
your message

NEED

Educators have always recognized the need for good communication between schools and homes, and the importance of a partnership relationship between teachers and parents. Recent experience and research has amplified the need for improved parent involvement, and Gandara (ref 1) indicated that the influence of the home may be even more powerful than the influence of the school. When rich and frequent parent/teacher interaction is present, there is a positive effect on student achievement, attendance, self esteem and parental attitudes (ref 2) (ref 3).

Communication between school and home is difficult. Both teachers and parents are busy, more parents are working and distance between home and school may reduce contact. When information flow is restricted, parents feel left out and uninformed (ref 4). Some schools only contact parents when there is a problem, emphasizing adversarial rather than cooperative relationships (ref 5).

OPPORTUNITY

Several trends in technology contributed to the concept described in this paper. The costs of intelligence and memory continue to decline. New uses of telephone technology have gained high popularity, including touch tone interactivity and increased use of the phone to save time and transcend distance. In the microcomputer environment, speed and flexibility has improved. And particular to this concept, digital voice capability has become highly dependable. With these trends, the integration of digital voice storage in the microcomputer for delivery of information by phone was possible.

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PLAN FOR RESEARCH AND DEVELOPMENT

In order to meet the need for improved and convenient communication between school and home, a customized system of digital voice technology was designed and adapted for use in educational settings. A technology-based system for parent involvement had to be easy to use and present a savings of time and energy. (Most parent involvement efforts in schools are very personnel intensive.) The system should concentrate on the vital and important information about he school program that parents can use. Messages from the school should enable the parents to increase and improve their support of the child's education.

When the first versions of the Compu-Call system were field-tested the cycles of trial and enhancements for school use showed a need to deliver a variety of messages during one calling cycle. The capability to store multiple messages, and to deliver these to a target audience at specified time intervals was designed into the system.

There was also an interest to deliver the messages from the school's computer to certain groups of parents or even groups of students. Some of the groups might be the members of the student council, parents who will volunteer to help with field trips, or parents of children entitled to the services provided by Chapter I. The records of these individuals can be flagged and grouped into "calling files" with a few key strokes.

During the early trials of the system, it became obvious that most people were not ready to hear a computer-based message without some preparation. Some hung up before recognizing that the message was from school and others tried to talk to the caller. A "greeting message" feature was added to prepare the parents before the body of the information is conveyed. When the phone rings and is answered, the listener will hear: *Hello, this is Sam Fleming, principal at Frost School with a message for parents. When a parent is on the line, please say 'ready'.* If the parent did not answer the ring, this gives time for the parent to come to the phone. If the parent answered initially, this orients the parent to attend to the message.

When the parent says 'ready', the body of the message is delivered. For example, *We are calling to remind parents that report cards for this grading period will be distributed to all students on Thursday. Please ask your student to show you the card, and discuss their grades with them. If you have questions, our teachers will be glad to talk with you. Remember, conferences are being scheduled for Monday and Tuesday of next week from 3-6 PM and we want all parents to meet with teachers on those days. Please call the office and sign up for an appointment - the number is 534-9000.* The greeting message pattern assures that parents will receive the message, and differentiates the call from sales or other nuisance calls. In some communities, there are parents who are more comfortable receiving messages in languages other than English. Compu-Call can match these families with an alternative language version of the same message.

It became apparent when working with school faculties that some staff development experiences were needed to help teachers and administrators optimize their use of the system. Of particular importance was brainstorming and team activities to generate creative applications of the new technology. For example, one school listed: (1) call parents with reminder to update immunization records; (2) ask the superintendent to record a message of congratulations to high-scoring students; (3) rumor suppression related to an outbreak of head lice; and (4) emergency parent notification on weather closings.

Some schools, particularly high schools, wanted automated parent calling to assist with school attendance problems. Some were using the tape-based first generation "electronic truant officers" and were interested in more flexibility, a positive approach, and data collection with report generation. In 1988 an integrated attendance management system was added to Compu-Call with the following features:

-- Automatic file updates and accumulation
-- report generation with school-set parameters
-- automatic designation of parents to be called when absences reach excessive levels
-- automatic formation of parent calling and matching with appropriate messages
-- problem-solving approach that encourages parent and student cooperation.

FULL SCALE FIELD TEST

A public elementary school (K-8) in Huntsville, Alabama was the site of the first field test, which took place during the 1987-88 school year. Compu-Call was installed in the office IBM-PC and was used by the principal, secretary and teachers to contact parents. Another field test was conducted in a secondary school in Mt. Dora, Florida and the system is also being evaluated in Clark Country, Nevada. In January of 1989 another system was implemented at Carter Lawrence Middle School in Nashville, Tennessee. Feedback from school personnel is used to enhance the effectiveness and ease of use of the system. The Betty Phillips Center for Parenthood Education at Vanderbilt University is assisting schools with implementation, staff development and evaluation.

SUMMARY

Schools can communicate with their parents by using a computer-based system of storing and sending messages to student's homes by telephone. The Compu-Call system accepts, stores and delivers information in the natural voice of the sender. The system uses data-based file management for both automated calling and attendance management, making operation extremely efficient and easy. There is one-time data entry, with categorical replacement of information in files; new calling files can be created with just a few keystrokes. This powerful system allows school personnel to communicate much more frequently with the parents, and allows major conservation of time and effort in the process.

NOTES

1. Compu-Call is a registered trade mark of Associated Computer Technologies, INc., 3237 N.W. 27th Avenue, Gainesville, Florida 32605.

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TECHNOLOGIES AND EDUCATION: ASPECTS OF CONTENT AND AN APPROACH TO IMPLEMENTING THEM IN THE EDUCATIONAL SYSTEMS

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ABSTRACT

The paper considers the impact of the new technologies onto the content, methods and tools in educations. Underlying in these considerations are the experience, current practice and the plans for the long-term development of Bulgarian secondary schools and Bulgaria's educational system as a whole.

The impact is first discussed of the new technologies on the educational contents and its updating in two aspects:

- training highly-specialized vocational specialist with secondary education to employ in their future work the new technology tools.
- ensuring all secondary-school leavers adequate training for the future requirements in their life and work in the context of the wide advent of the new technologies.

Special attention is paid to how technologies influence instruction methods and tools and require changes in educational subject-matter. The problem is treated in terms of contents, and the approach is especially stressed to the mass introduction of the new technologies in secondary education.

The idea is discussed of the synthesis between science, informatics and computers as a strategic factor in social development. The major directions to achieve this synthesis in education are considered.

Some organizational problems are also treated, as well as the ways and approaches to their solution in the context of centralized educational systems, as is Bulgaria's.

INTRODUCTION

Material production is what inderlies any civilization and every society. The techno-scientific standards of any industry are dictated by its technology. To improve production one improves technology. There are, of course, limits to this process. For progress to be registered from a certain stage on, radically new technologies are needed. Over the last couple of decades a variety of truly radically new technologies appeared, to become essential in industry, management, business, communications, and every-day life. Education was not to lag behind.

TECHNOLOGIES AND EDUCATION

The educational system of any country has two major tasks:

- to train young people to live and work in the context of a specific social system;
- and to train highly-qualified specialists to meet the demands of the national economy and society.

These two tasks are tackled on various leves in Bulgaria's educational system: in the basic, secondary and higher education. For the higher education primary in significance is the second task. Content-related problems in higher education are handled by the higher institutes of learning themselves, individually. In terms of content, the system of the secondary education is centrally managed on a national level. Subject of the present contribution is the impact of the new technologies on the subject-matter, learning methods and tools in secondary education.

One of the characteristic features of Bulgaria's educational system is the provision of a vocational training within the framework of secondary education. The objective is to provide each secondary school leaver with some professional qualification. In this sense the two major tasks of secondary education, in terms of the new technologies, boil down to:

- providing general knowledge about the fundamentals of modern technologies to all young people;
- training highly-qualified narrow specialists with secondary education to work with the new technologies.

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Formulated thus, these two tasks seem both logical and natural from the viewpoint of what modern technological societies require of young people to get an adequate realization and live well-adapted in them. What is more difficult to determine is:

- which is the basic range of technological knowledge and skills forming the general educational technological basis which should be regarded as a must for the majority of young people to know;
- which are the modern technologies characteristic of the technological society in the respective country.

THE NEED OF NARROW SPECIALISTS WITH SECONDARY EDUCATION IN THE FIELD OF THE NEW TECHNOLOGIES

Five priority areas, related to the new technologies, have been deliniated in Bulgaria's economic development:

- electronics, robotics and machine tools;
- bio- and chemical technologies;
- production and implementation of transportation systems on the basis of a synthesis between electronics and transport technology;
- creating a new raw-material base;
- development of laser technology and optoelectronics.

Common for these five complexes is the need for:

- automatic control;
- introducing CAD/CAM and CIM systems.

It is evident also that there is a common need of introducing new information technologies.

As the degree of automation and automated technology control grows, so does the role and the relative share of secondary school specialists working in the respective industries. On the other hand, due to the influence of the progress in science and technology on production, the branches of material production get increasingly differentiated and closely specialized. Simultaneously, a process of integration takes place uniting the individual sections or direction of production into a complex whole of a technological process. Taking into account these two contrasting processes, it is necessary to determine the general technological basis which to be studied in the specific professions and subjects, and which is to serve as the grounds for the narrow specialization in the respective technology.

These problems may be solved by studying the current and future needs of personnel for the industry in the respective fields. Also the list of professions and subjects for vocational education should be updated in view of these needs, and schools or courses in some subjects opened to meet these needs.

THE NEED FOR GENERAL EDUCATIONAL TECHNOLOGICAL TRAINING OF ALL YOUNG PEOPLE

Irrespective of their specific subject of vocational training, to work and live in a technological society makes it necessary for young people to have basic polytechnical and technological training. A technological society is characterized by a highly automated production, transport, communications, intellectual activities and social management. Underlying each automation is the control process which, as is common knowledge, is an information process. So the majority of young people should also have a basic training in the information technologies.

Providing a basic polytechnical and technological training, including in the sphere of the new information technologies, is a major task of the educational system. To solve it, efforts are invested in several directions:

- to implement the polytechnical principle and the integrative approach to presenting and learning the subject-matter in the various subjects;
- to provide basic polytechnical knowledge and skills, and knowledge in the fundamentals of technologies;
- to provide knowledge in the fundamentals of the information technologies;
- to ensure conditions for young people to obtain additional optional knowledge in a definite narrow technological field.

The polytechnical principle, in the wide sense of the word, is applied to organizing the subject-matter so as to reveal the underlying relationships within the subject and among subjects in studying processes and phenomena, in order to stress upon their material nature and general scientific interest. The strongest cases in point here are chemistry and physics, physics and electrical engineering, chemistry, biology and biotechnologies. The courses in chemistry and physics come after a course in 'physio-chemical properties', studied as early as the sixth grade.

The integrative approach is manifest in studying what is common for the different subjects, without separating them artificially or in studying what is common for subjects different in nature. Coming under this approach is also the application of the methods and tools of one subject to another, or even the joint studying of the two. For some years now we have successfully been experimenting in studying language and mathematics parallelly, as well as mathematics and informatics.

Our endeavour to implement the polytechnical principle and the integrative approach is dictated by several considerations, among them being the realization that the new technologies are a complex product of the interaction of many sciences.

To provide basic polytechnical knowledge and skills and knowledge in the fundamentals of the technologies a special school subject has been introduced to be covered, under different names, throughout the course of secondary education, from the first to the tenth grade. The new system for polytechnical and technological training envisages the following subjects:

— I stage 'Work and Create' — first to third grade;
— II stage 'Technics and Technology' — fourth to seventh grade;
— III stage 'Science and Manufacture' — eighth to tenth grade.

Proceeding from the premise that mass-scale polytechnical and technological training is an element of the general educational culture and a basis to mastering a profession, the subject-matter in the above subjects is built on elementary technological modules in accordance with the age characteristics and capabilities of students;

— in the first stage: basic mechanic procedures in materials processing; basic modules of agricultural and ecological technologies; technologies and every-day life and others;
— in the second stage: modules of physical and biological technologies; robotics, motors and drives, etc.;
— in the third stage: the subject termed 'Science and Manufacture' is studies, which reveals, in its theoretical part, the relationships between science, informatics, computers and industry, and its applied, practice-oriented part includes instruction in robot engineering and CIM, and production activities in the field of the physical, chemical, electronics, informatics, biotechnological and ecological technologies.

In each of the three stages the subject-matter falls into three parts: compulsory material, optional part and extra-mural classes. Thus, for the third stage, the extra-mural classes offer the following subjects:

— computer science;
— CAD/CAM systems;
— automation of laboratory experiments;
— lazer technologies;
— biotechnologies;
— synthesis of electronic and industrial technologies;
— optoelectronics, and some others.

Thus the compulsory instruction can be coupled with studying additional material, chosen according to the interests and preferences of each secondary school student.

EDUCATION AND THE TECHNOLOGIES

To develop and employ the new technologies, well educated specialists are needed, and it is up to the system of education to provide them. On its part, the educational system needs new technologies to get improved. How are the technologies to contribute towards its improvement? There are various ways. In any case, however, it is a matter of changing instruction methods and tools under the influence of the new technologies. It is a matter of introducing a new educational technology in a new learning medium, abounding in instruction tools.

In our opinion, instruction methods must abide by the well-known principle: 'I listened and forgot, saw and remembered, did and understood'. The learning medium should also be organized according to that principle. It must consist of:

— textbooks and teaching manuals and aids;
— a conceptual model of the learning medium;
— methodological guidance as to the technology of education;

- learning tools;
- educational software, etc.

The learning tools and the educational software must serve to build up the conceptual model of the learning medium. The new technologies have greatest impact on the development of learning tools, most of the latter being based on them, or having a possibility to. Various technological modules, technological lines and industrial units of learning purposes may be employed in education. Another quite important factor is achieving actual production in learning or industrial conditions.

The problem of education and the new information technologies should be given special consideration. These have considerably influenced the educational system, and will continue to do so ever more intensively. For a number of years now work has been going on in Bulgaria to introduce new information technologies in education /1/. Most relevant in this respect have been the activities on implementing the national programme and project on bringing in computers in secondary schools /2/. The results achieved are judged to be quite significant. At present each secondary school is fitted with at least one computer classroom of about 20 workstations. At this stage computers are primarily used to ensure the general educational training of all students in informatics and computers science. We believe this training to be a major prerequisite to employing computers as a learning tool in various other subjects. Research is now directed towards developing computer-oriented and computer-based learning methods and media in various school subjects. These efforts are integrated under a large-scale comprehensive programme, launched in 1986. Its first stage is to be completed by 1990. Besides research, the programme envisages building up material facilities and upgrading teachers qualification. The aim is to provide comprehensive scientific, methodological, organizational and technical prerequisites for a mass-scale introduction of new information technologies in all schools.

THE SYNTHESIS BETWEEN SCIENCE, INFORMATICS AND COMPUTER TECHNOLOGY AND ITS IMPLEMENTATION IN EDUCATION

Control is underlying the entire modern industry and many other fields of human activity. The complexity of the objects and processes to be controlled require a great amount of automation and intellectual effort. Such control is impossible without computer technology. It cannot be achieved, either, without employing the methods and tools of informatics, and indeed, without science, without the knowledge about the nature of objects and systems and about the laws of their functioning. Each of the above three elements is, by itself, just a necessary prerequisite to achieve such type of control. So these three prerequisites must be combined into an organic whole, a synthesis between them must be achieved. Such a synthesis is essential for science itself, where it serves three major functions:

- a tool, generating new scientific discoveries and inventions and providing greater insights into science itself;
- a factor for raising significantly the efficiency of pure and applied science;
- an impetus for radically new technical and technological developments.

The theoretical argumentation of the necessity of a synthesis between science, informatics and computer technology pose radically new tasks to education. Above all, computer-based learning modules have to be implemented as well as computer-based learning media within the context of the computer-oriented approach to education now being introduced. Drawing from what that synthesis means for the other spheres of human activity, we consider the following to be major directions in which efforts should focus in the sphere of education:

- revising the methods of teaching, acquiring and processing information in the course of learning. Revising also the respective approaches and tools.
- introducing in practice the new approaches and tools in learning;
- enabling students learn to use computers in various professional activities;
- orienting the entire vocational training of young people towards employing on a large scale computer technology, CAD/CAM systems, technological lines, robotized sectors of production and CIM systems of learning purposes, and new educational technologies.
- training narrow specialists with secondary education in the area of the new technologies.

INTRODUCING NEW TECHNOLOGIES IN CENTRALIZED EDUCATIONAL SYSTEMS

The centralized educational systems, such as Bulgaria's, offer a number of advantages in the introduction of the new methods, tools and technologies of education. These advantages are manifest both in the course of research and developing learning media and technologies, and in their mass-scale introduction in learning practice. The centralized financing and development

of learning media is conducive to an optimal distribution of resources. It makes it possible to organize competitions and choose the best programmes, to enlist the best experts, which finally allows the best projects to be introduced on a mass scale throughout the educational system.
To introduce the new learning media and methods, specialized bodies and respective mechanisms can be built. Their mass-scale introduction is ensured by the existence of unified curricula and sylabuses and the centralized distribution of textbooks and teaching aids.
To achieve an optimal utilization of finances inter-school centres of polytechnical and technical education have been established in this country. The facilities there, often quite expensive, are shared by several schools.
The problems, arising in many schools are to a large extent similar. Their centralized resolving calls for a single decision and manyfold implementation, which is both efficient and economic.

CONCLUSION

The impact of the new technologies on the subject-matter, teaching methods and tools of education is both inevitable and necessary. It is yet to grow. In this respect, it is very important to determine correctly the generally needed and indispensable technological basis and its content, and to conduct education respectively.
The influence of the new technologies, especially of the information ones, on education, has brought about the necessity to bring in new education technology and new learning medium in schools. This necessity will also grow in the future.

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OPEN SYSTEMS THINKING AND INTEGRATING EDUCATION AND TECHNOLOGY

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ABSTRACT

As people have developed blueprints for the integration of education and technology, they have typically focused on the technology rather than the broader educational context. As open system paradigm permits a more macro examination of the questions educational leaders must consider as they develop a technological agenda. At a societal level, the impact of locating massive, sophisticated technology in a state like Texas has enormous implications on the educational and political system. Open systems approaches offer a unique opportunity to examine these new developments and to suggest a more effective long-term agenda for education.

It is no accident that so many of the complaints against organizations today center on quality, service, productivity, the inadequate methods used to lead and manage these organizations, and the competence of executive and managerial leadership. Many businesses operate as though the past were present-simply out of date. Depending on the routine. Tried and true strategies. In effect, American institutions are trying to sail today's enterprises into the sea of tomorrow aboard yesterday's vessel.

This challenge, faced by most organizations in this information age include government, business, industry, religion, justice, and corrections, as well as education. Traditional forms of organization and strategies of operation are proving inadequate for the tasks at hand. Essentially these historical times demand a shift from the unilateral strategies of bureaucratic values like "doing it my way" to maximize winning, minimize loosing, to the more democratic collaborative strategies of values like free and informed choice and valid information. We need to shift from a preoccupation with structure for structure's sake to a prime concern with the functions to be performed and the best process to achieve results; from power based on position to influence based on the demand for quality products and services and the efficiency, effectiveness, and competence needed to successfully compete. Failure to look simultaneously parallel process new technology, human concerns and human skills to utilize as well as existing cultural of symbolic systems, political systems and structure simply will not achieve the necessary people person matches.

Bureaucratic organizations by definition embody unilateral strategies which tend to further produce routine. Alternative strategies are attempted with the production of partial and inadequate solutions. A non-problem solving mode develops. A person's authority and power are derived from position in the hierarchy; planning and decision-making occur at the top and flow downward in a one-way sequence of cause and effect. This phenomenon creates dependency in subordinates and reduces quality and performance.

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The prime point is that a stable structure is the means of maintaining order among people so that they may progress in tune with the stable world around them. To illustrate the significance of structure in human affairs, it is only necessary to look around. Whereas in medieval times every person had a proper station in life. Today everyone has a specialized skill or profession (or neither) which determines his/her position and degree of (or lack of) authority. In virtually all organizations, the individual must fit into a specified box on a flow chart, which typically is larger in reality than perceived to be by the incumbent. In America, we are rapidly developing a society of haves and have nots.

It rarely has been necessary to question the purpose of a work group, an organization, or a society. Authority remains a function of position and bureaucracy has been self-perpetuating. Those in authority perpetuate the routine in the name of social order. They have trained young people to understand the past and to adapt to the demands of social stability. Rules, policies, and laws have been formulated (and enforced) which simultaneously enshrined stability and emphasized the routines of bureaucratic management like one way communication and unilateral decision making.

The bureaucratic pyramid can be challenged on grounds that it is autocratic, anti-democratic, and based on unsound principles. The truth however, is that bureaucracy was admirably suited to the tasks of its time maintaining stability.

Modern technology has moved our society beyond the industrial age. Now change must be effectively managed in order for people to survive. Adaptability becomes key to stability and growth.

Human life is not mechanistic, not dependent upon cause-and-effect relationships, and not exclusively rational. Instead, it is organic, fluid, dependent upon interpersonal and intergroup relations and intuitive, embracing not only intellect but emotion and demands connectedness or involvement.

There exist many windows into or ways of viewing of organizations. Systems thinking allows for a more organic view of organization life. Systems theorists discard the authoritarian, bureaucratic pyramid and substitute a dynamic organizational form featuring give-and-take relationships between all segments of a system, and between whole systems which combine to form larger ones.

Feedback, feedforward and feedthru-the two way and multi-relationships among and between organizational units--and form key operating principles, fundamental to organic process. If all the interaction occurs within the organization, it is a closed system. If interaction occurs both within the organization and between it and other organizations, the system is open, organic, affecting and affected by its environment.

Open adaptive systems embody the democratic process, and democratic process provides an essential ingredient for creating the adaptability required for survival of a postindustrial society. While bureaucracy with unilateral decision making may be exceptionally effective over short periods of time, the absence of feedback to the controlling agent will lead ultimately to failure. In contrast, an open more democratic and collaborative system, that stresses trust and encourages full, two-way interaction between all its parts and with its environment, possesses the resources for unlimited self-renewal.

Contemporary American organizations are a curious mixture of open and closed systems. Most of these organizations are frozen into the bureaucratic mold. It is not surprising that social institutions of American society have followed this pattern. It is disturbing, however, that our organizations have been slower to recognize the need for change. Selected organizations have been slower to recognize the need for change. Selected organizations are trying some open system applications. Early reports indicate that it is highly promising as a means of aligning people according to common purpose and improving communication between an institution's constituent groups; helping members set goals and objectives and making the institution more responsive to technological change, political, economic, and most importantly human needs.

The open system calls for an examination of values people hold, the adoption of new processes in order to broaden the information base for decision-making and to insure the participation of all constituent groups. Planning must focus on the integration of individual and group goals and objectives into common, organization-wide efforts. It is quite likely that an open-system approach, if used effectively, will result in some revision of existing organizational structure, but, such revisions will be subordinate to, even dictated by, the changes in process, changes in technology and the resulting needs to learn or adapt.

Ultimately, with open interaction between constituent groups, authority and influence will be related decreasingly to position and increasingly to vision, common purpose to competence and credibility. Such an approach will not succeed unless the existing power structure of the institution is willing, even eager, for that success. Chances are, too, that leaders who are willing to open up the decision-making process will have little to fear from the outcome. Initially, at least, the new decision-making processes will work only to the extent they are supported by those in power.

ONE WAY TO DEPICT AN OPEN SYSTEM

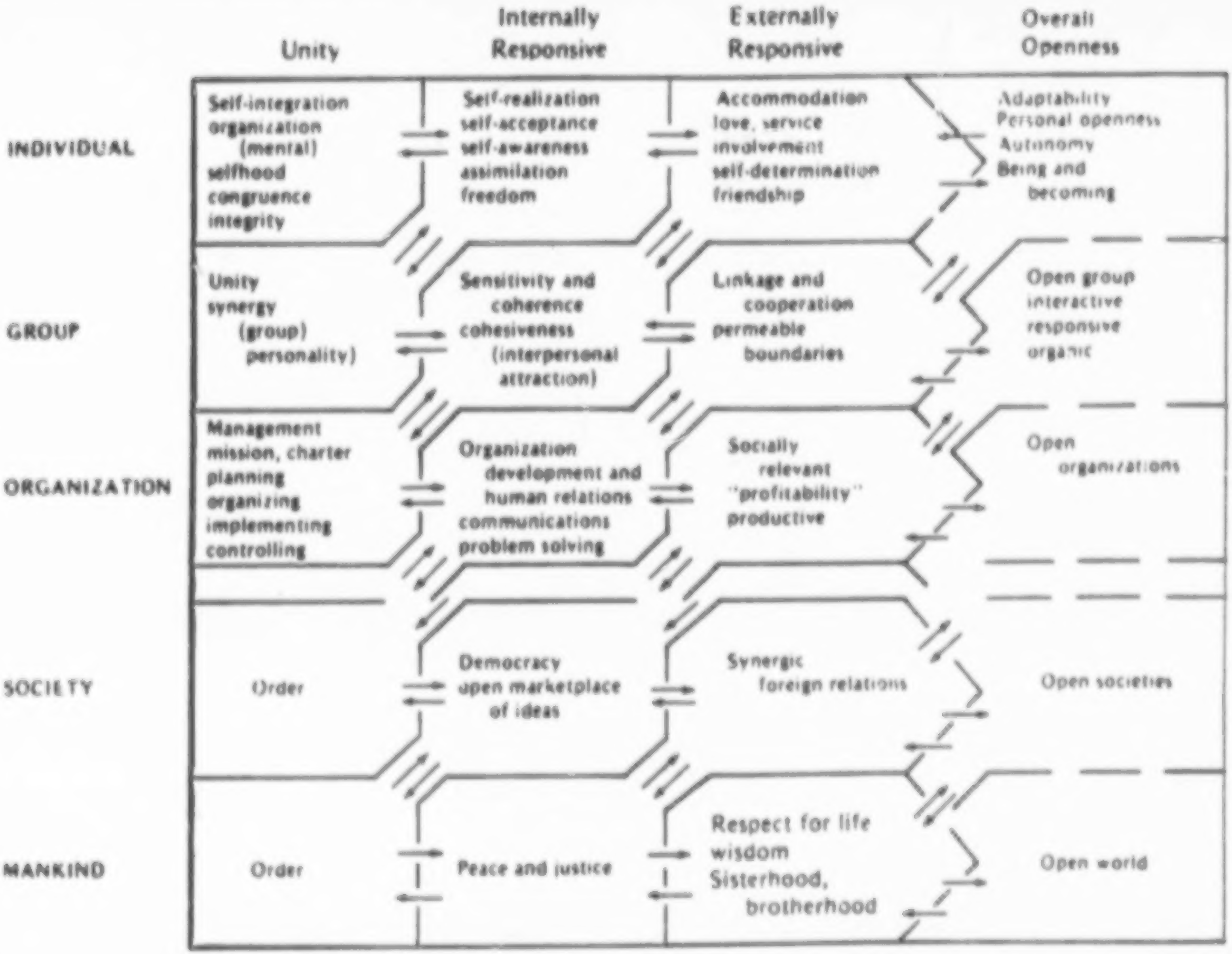
Figure 1 depicts one way to view an open adaptive system.

The three characteristics of integrated whole, internal responsiveness, and external responsiveness may be used to describe the entire organization, or its subsystems. The open organization model looks at these characteristics at three levels: the individual person, the work group, and the entire organization. As shown in Figure 1, the model also indicates the interchange among the three levels in terms of these characteristics. For example, a complementary relationship exists between the external responsiveness of an individual and the internal responsiveness of his or her work group. When a work group is composed of people with high involvement and concern for one another (external responsiveness), the group's internal responsiveness will be high. Conversely, if a group suffers low internal responsiveness, individual members need to develop greater involvement and commitment to the group.

To understand more concretely the characteristics at each level and the relationships between levels, trace the examples of each characteristic at these levels. Integrated whole for an individual is self concept--"I know who I am and appreciate my uniqueness." Internal responsiveness on the individual level is awareness of one's wants and needs and permission to fulfill them. External responsiveness on the individual level is defined as interaction with others in the environment which produces mutually beneficial results. External responsiveness on the individual level is reaching out, listening, responding, being open, attraction, positive stroking in transactional analysis terms, or old-fashioned affection and love.

If the basic unit is considered as the team instead of the individual, integrated whole involves concern with team goals. Are all team members moving in the same direction? Are there team goals and objectives? Are team members committed to these goals? Internal responsiveness on the team level means members of the team are aware of one another. Are team members sensitive to others members' needs and wants? Are there good relationship skills in the team? External responsiveness on the team level is cooperative interaction with other teams or components within the organization. Does the team link with other teams? Does the team gather information relevant for team problem solving from other sources? Does the team support organizational goals?

Achieving integrated whole on the organizational level involves organizing according to purpose. Is there a sense of where the whole organization is moving? Internal responsiveness on this level is the way different components within the organization interact. Do departments gather information from other departments? Do they share problems? External responsiveness of the organization level is the way the organization interacts with the larger community. Does the organization gather information from its environment for planning and setting goals? Does it provide data to other organizations? Does the organization provide relevant services to constituent groups?



	Unity	Internally Responsive	Externally Responsive	Overall Openness
INDIVIDUAL	Self-integration organization (mental) selfhood congruence integrity	Self-realization self-acceptance self-awareness assimilation freedom	Accommodation love, service involvement self-determination friendship	Adaptability Personal openness Autonomy Being and becoming
GROUP	Unity synergy (group) personality)	Sensitivity and coherence cohesiveness (interpersonal attraction)	Linkage and cooperation permeable boundaries	Open group interactive responsive organic
ORGANIZATION	Management mission, charter planning organizing implementing controlling	Organization development and human relations communications problem solving	Socially relevant "profitability" productive	Open organizations
SOCIETY	Order	Democracy open marketplace of ideas	Synergic foreign relations	Open societies
MANKIND	Order	Peace and justice	Respect for life wisdom Sisterhood, brotherhood	Open world

LEVELS OF OPEN SYSTEMS.

MANAGING THE COMPUTER AS A SCARCE RESOURCE:

the solutions of five teachers in three European Primary Schools.

Derek Blease

ABSTRACT

A longitudinal study of five teachers in three European primary schools indicates that the apparent restriction of having just one computer available in each classroom can be used to the positive educational advantage of both teachers and children. The disadvantages of social and educational isolation of individuals resulting from a "one computer per pupil" policy, are avoided by forcing teachers to employ small group and whole class activities where individuals spend relatively small amounts of time at the keyboard.

Five teaching strategies are identified and discussed and it is suggested that the acquisition of computer literacy and information handling skills, and the development of concepts amongst both pupils and teachers, is enhanced by ample opportunities afforded by these methods for the discussion and sharing of ideas about the new technology and its use, rather than diminished by the relatively short periods of time spent at the keyboard.

INTRODUCTION

This paper represents just one small part of the work of three teams of researchers working with teachers and children in three primary schools, one in England, one in Belgium and one in France, over a period of eighteen months commencing in 1986. Funded by the European Commission, the project set out to look at the ways in which information technology could become integrated into the primary school curriculum. For this purpose, teachers were chosen who had not previously used a computer in a professional capacity to any great extent. All of them worked in a typical school of their area which had not previously been the subject of other research investigations. The English school, situated on the outskirts of a Leicestershire Market town, catered for approximately 250 pupils from 5 to 11 years of age. Two vertically grouped 3rd and 4th year classes, (25 pupils in each, 9-11 years of age), and their teachers participated in the project. The Belgian school was situated in a rural community close to Liege in the French speaking part of the country. The school caters for approximately 200 pupils of which two 5th year classes, (15 pupils in each, 10-11 year of age) and their teachers participated. The French school was situated in Paris where one fifth year class, (30 pupils, 10-11 years of age), and their teacher participated.

The role of the researchers was essentially that of persons providing resources. They planned the initial training in the use of the hardware and gave clear information on the main types of commercially available software. They responded to technical and pedagogical breakdown during the course of the investigation as well as making detailed observations of both pupil and teacher behaviour.

One of the most striking aspects of teacher behaviour observed during the project was the way in which the teachers, within individual schools, independently devised their own ways of managing the computer in the classroom. As relative novices with the new technology, they had to find ways in which to integrate a single computer, or at most a small number of computers, into their normal ways of working, in such a way that they could effectively manage the learning process. In the course of the three school terms of classroom observation, five particularly interesting strategies emerged, several of which were common to all five teachers even though there was no formal communication or collaboration between the individual schools.

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FIVE TEACHING STRATEGIES

1. Managing the resource single-handed

a) The computer as just one of many activities:

In order to manage the computer single-handed it was important for the teachers to come to see it as yet another classroom resource, or the centre of a particular and well defined activity. The single computer does not easily lend itself to whole class teaching and so right from the beginning it was often seen as just one activity among many others. Although situations differed between the three schools, this strategy was observed in all three countries. The "open-plan" organisation of the English school probably lent itself to this most readily since group work, where a variety of activities are going on at one time in the class area, was already a common way of working. While one group might be working on a mathematics exercise, another might be reading or writing, and another would possibly be involved in model-making or artwork, it was not difficult for the teachers to add another group activity involving the computer. In the Belgian school, small group work was not uncommon, but children worked in a more conventional classroom setting, often with a small number of computers in a separate room. This arrangement created additional difficulties for the Belgian teachers, having to divide their time between two locations. In general this meant that they had to devise computer-based activities which were relatively self-contained. In the French school there was only one computer, which was housed in a separate classroom. In order to use it the teacher had to take her whole class to that room and organise her group to work there. Since there would be demand for the use of that room by other teachers, it was more difficult to rotate groups so that every child got computer experience within a short space of time.

b) Teacher demonstrations and discussions using a large screen:

On those occasions when a whole-class activity was considered appropriate, the teachers chose to adopt the large screen T.V. in place of the conventional monitor. In general the picture quality was less satisfactory but this was offset by the greater visibility of the screen to the larger group. In England the children were introduced to interrogation of a database, creation of a newspaper and the use of Teletext in this way, but the major activities which followed these introductions were always conducted in small groups of three or four children. In Belgium the use of one computer for a whole class activity involved competing teams using the same program, and so visibility for the whole class was less important. In France, many lessons using LOGO started with the whole class. Some activities even started with work on the blackboard which children copied into their books before taking it in turns to try out their solutions on the computer in front of the rest of the class. If other children disagreed with the solution they were encouraged to discuss and criticise it before the final version was put to the test.

c) Use of short and easy exercises to enable a quick rotation of pupils when first introduced to the computer:

When the computer was first introduced to the children, the teachers all felt it necessary to encourage the excitement and high level of motivation by making sure that everyone got a chance to try a short activity very early on. The best example of this was in Belgium where one of the teachers commented:

"In view of the limited number of machines and the motivation of the children who were tackling them for the first time, it seemed a good idea to choose a short, easy exercise which allowed each pupil to get to a keyboard quickly. We organised a small competition between two groups of pupils, the objective being to develop a strategy whereby a higher score was achieved after each new exercise."

2. Eliciting the help of others

d) Children teaching children:

One of the most effective teaching strategies adopted in the English and Belgian classrooms was for more experienced children to act as tutors to the others. This invariably took place in small group settings where composition of groups could rotate, introducing a novice child every time a more experienced child left the group. The best example of this occurred in the English school when the teachers introduced a database. All the children had collected data from the gravestones of a local churchyard. The objective was to create a datafile which could be interrogated to find out as much about the inhabitants of the village in years gone by. Once a small number of children had been shown how to enter individual records, groups of three were arranged with a definite division of labour. One child operated the keyboard, one child read out the information to be entered while the third checked that the screen entries were correct and performed and calculations of ages and dates that might be required. As each child completed the entry of their own data they were replaced by a new child who was then taught what to do by the other two. This process continued until all data was entered and each child had performed each of the three tasks. In Belgium a similar method was used when using a wordprocessor, and during the use of "drill and practice" programs the teachers found that it helped solve the problem of having children working in two classroom at the same time. A more experienced child was always paired with a less experienced one so that fewer demands were made on the teacher to solve minor difficulties.

e) Parents used as helpers in the classsroom:

It is not unusual for parents to be encouraged to help in British Primary school classrooms. Traditionally they have listened to children read, worked alongside children when doing art and craft work or assisted with such things as cookery or swimming, all under the direct supervision of the teacher. Following a parents' evening held in the school to demonstrate what the children had been doing with the computers, a small number of parents became involved with computer work with younger children in the school, something which has continued to the present day.

3. Preparing additional resources to save teacher time

f) Preparation of simple instruction cards to free the teacher to work with other groups:

The introduction of a computer-art package into the English school created many organizational problems since the instructions provided in the manual were not very easy to follow. Although the two teachers were quick to see the educational potential of such a program, they found that the time demanded to become sufficiently familiar with all aspects of its use, that even the simplest problems encountered by the children could not be dealt with quickly and efficiently. This meant that the program was potentially a serious disruption in the classroom. This problem was finally overcome when a set of simple instruction cards were produced which presented examples of the various modes of operation of the program accompanied with easy to follow instructions of how to achieve various effects. These cards were simple enough for the children to use, and provided a means whereby parent-helpers could quickly become involved in the supervision of the work.

In France this took a rather different form in that the teacher prepared a series of twenty worksheets containing a variety exercises for the children to try out on the computer.

4. Facilitating the planning of work away from the computer

g) Plan screen layouts on paper first (Computer Art and Teletext):

Much work involving graphics can benefit from layouts being planned on paper before they are tried on the computer screen. This was the way in which the two English teachers coped with demand for computer time when using the computer-art and Teletext emulator programs. Designs were worked out on squared paper, and in the case of Teletext, group decisions were made about how colours and other graphic effects were to be achieved. These were then plotted onto a specially prepared grid sheet.

Although wordprocessors are designed so that the writer can compose text at the keyboard, this is often not practical when only one computer is available in the classroom. In both England and Belgium, children were encouraged to produce group compositions on paper, an activity which encouraged cooperation, discussion and argument before a final draft was produced. It was only then that the text was typed, with special attention being given to layout and presentation.

h) Write it up first (eg. LOGO) and go to the computer to see if it works:

In France, the children were constantly in competition for the computer to test out their LOGO procedures. To overcome this problem the teacher created a series of group activities which required verification at the computer at different times, thus staggering demand.

5. Using the computer to direct children to other activities

i) Much work done away from the computer:

The most striking thing about the activities in all five classrooms was the amount of work done away from the computer. Naturally, having a limited number of computers available makes this inevitable, but in reality the result seemed to encourage good computer habits. In other words, other more appropriate resources were not neglected, children were encouraged to research, plan, discuss, revise and edit. LOGO procedures were planned on paper first and then tried. In Belgium, a database activity involved five different "off computer" activities, oral expression, vocabulary and spelling, grammatical spelling, written composition and preparing a table, and only two "on-computer" activities, entering data and interrogation of files.

j) Move from computer-based activity to other methods and media:

In many cases the computer programs themselves demanded that children look things up in books or tried an experiment. Much of the time spent away from the computer actually served to consolidate the children's understanding of the strengths and weaknesses of the new technology. Experimenting with the computer-art program led one English boy to discover how to achieve more dramatic effects when working with conventional paper and paint.

k) The computer as a setter of problems and a checker of results:

In the Belgian school they used a program which was designed to develop problem-solving skills. The children were divided into groups, each group being given a set of tourist pamphlets and travel books. The computer would set each team a problem to solve to find the location of a particular town or city which they could only do by deduction and teamwork using the resources provided. The role played by the computer was simply to set the problems and check the responses. Another program actually set periodic tests to indicate the pupils' progress in drill and practice language exercises.

l) Children writing about using the computer to consolidate their understanding:

A database activity in the English school led to a remarkable wall display of the children's work, little of which was direct computer output. Children wrote about defining fields and collecting data. They described the process of entering records, formulating questions and interpreting results. The quality of this writing surprised us all, but it is important to remember that it had only been possible because the teacher had encouraged the children to think about what they had been doing and why, rather than just getting bogged down with the technical aspects of computing.

CONCLUSION

When the project began it was felt that the shortage of computers in the five classrooms was going to be a major disadvantage. What emerged as the work progressed was a situation in which disadvantage was turned to advantage. The teachers devised ways of working which capitalised on the need for children to work in groups. This work enabled them to develop skills of communication, cooperation, planning, revising, hypothesising, testing and editing in unique ways while still retaining opportunities for individualised learning. They were able to encourage the children to teach one another, to take some responsibility for their own learning and even fostered the involvement of parents. Children who were not using the computer rarely felt left out as they could become absorbed in activities which either derived from previous computer work, or were in preparation for the next session at the keyboard. While all this was going on the new technology was quietly becoming an integral part of classroom life before our very eyes.

TECHNOLOGY PROTOTYPE LAB: HOW TECHNOLOGY MOVES FROM THE MILITARY AND INDUSTRY TO SCHOOLS

G. W. Orwig*

ABSTRACT

Faculty at the University of Central Florida College of Education, working with the Institute for Simulation and Training, are designing a Prototyping Classroom to facilitate the transfer of training technologies from the military and industry into the public schools. This paper describes the project and discusses some of the human factors that enter into the initiation of transfer of training technologies.

INTRODUCTION

My position as a faculty member in the Instructional Technology Program at the University of Central Florida provides me with a rather unique vantage point from which to view activities in the domains of education and training. The program is housed in the College of Education, and one branch of the program is designed to prepare public school media specialists. However, a second branch of the program is designed to prepare instructional systems designers for business and the military. Since several of our courses are shared, I am often witness to impromptu "cultural exchanges" that take place among the class members. It can be most enlightening to observe a couple of elementary school media specialists working with a couple of officers from the Naval Training Center on a group project. It seems like very little is accomplished until each member of the group manages to see past his or her initial preconceptions (often misconceptions) of what the "other" side is like.

TRANSFER OF TECHNOLOGIES: A BEGINNING

You might have learned from a science class a long time ago that nothing starts moving unless energy is first applied to it. If technology transfer is to take place, it is critical that trainers and educators involve themselves in each other's domains. Perhaps a process with the greatest potential for initiating the transfer of training technologies is the visiting scholar / visiting expert approach. Teachers need to spend part of their summers working with the military and businesses in training departments, and instructional technologists and trainers need to make regular "guest appearances" in the schools. While these visits will not solve all transfer problems, they will get both sides talking, and will provide that initial quantity of energy that is needed to get the transfer process into motion.

WHAT WORKS WHERE?

In addition to getting trainers and educators into situations where they communicate, it is also essential to establish formal testing procedures to determine which technologies are appropriate for transfer. The military has learned an expensive lesson in trying to implement new technologies into full scale on-going training sequences. The new ideas don't always work as expected, and in the meantime a large number of new trainees get tangled up in the system because of the delays. Similar problems would arise in education if this testing did not take place.

PROTOTYPING LABORATORY

Faculty at the University of Central Florida College of Education, working with the Institute for Simulation and Training, are designing a Model Prototyping Laboratory that will allow researchers to conduct unbiased assessments of training technologies and to evaluate their potential for transfer into the educational environment. This laboratory, currently funded through the State of Florida High Technology Industries Council, is designed to interface with the Naval Training Systems Center and associated agencies of the Department of Defense, defense oriented contractors, the University of Central Florida research community, and the public school systems of Central Florida.

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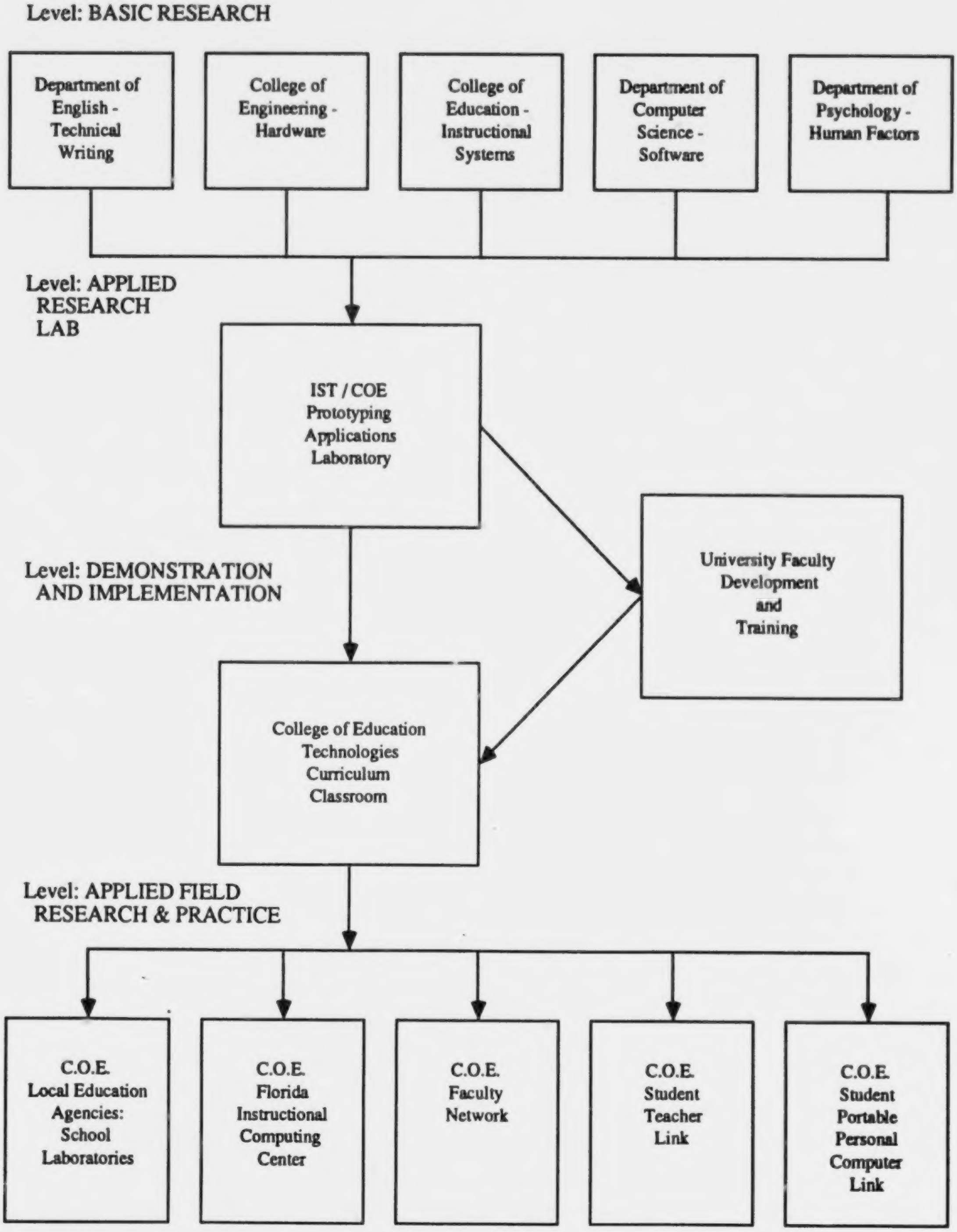
Level: BASIC RESEARCH
Department of English - Technical Writing
College of Engineering - Hardware
College of Education - Instructional Systems
Department of Computer Science - Software
Department of Psychology - Human Factors
Level: APPLIED RESEARCH LAB
IST / COE Prototyping Applications Laboratory
University Faculty Development and Training
Level: DEMONSTRATION AND IMPLEMENTATION
College of Education Technologies Curriculum Classroom
Level: APPLIED FIELD RESEARCH & PRACTICE
C.O.E. Local Education Agencies: School Laboratories
C.O.E. Florida Instructional Computing Center
C.O.E. Faculty Network
C.O.E. Student Teacher Link
C.O.E. Student Portable Personal Computer Link

Figure 1. Technology Prototyping Lab

As illustrated in Figure 1, there are two physical components to the Prototyping Laboratory. Located at the Institute itself there is an Applications Laboratory that serves as a primary testing facility for new training technologies. In this lab, ideas and devices are tested under realistic conditions for potential implementation problems that couldn't be detected in the basic research lab settings where the discoveries took place. At this point, technologies that don't have proprietary or security limitations are also screened for the potential transfer to public school settings. If a new technology shows promise for transfer, then educational experts are called in to conduct additional tests to determine what types of modifications, if any, might be needed to make the new technology appropriate for educational use.

The second key physical component to the Prototyping Laboratory is a Technologies Classroom located in the College of Education. It is in this classroom where both beginning and continuing teachers work with the new technology. If it is a delivery system, they not only learn about it, but they also design and deliver instruction for it. If the new technology is a model for the design or management of instruction, then the teachers apply the model, using their own areas of expertise.

In addition to the physical components of the Prototyping Laboratory, there are conceptual components of equal importance. Because many of the issues under examination require areas of specialization, pools of experts are being identified from several sectors of the community. These pools include:

- A group of K-12 teachers, representing a variety of subject areas, noted for their exceptional teaching achievements in the classroom.
- A group of College and University faculty from throughout the Southeast. Each faculty member is known for his or her research expertise in a field of technology related to training or education.
- A group of military and industrial research scientists who are experts in emerging technologies.

These pools of experts will be "on call" to set up problem solving teams for research issues that arise during the activities of the Prototyping Laboratory.

PLANS FOR THE FUTURE

The Prototyping Laboratory is new and is still evolving. The total activities of the Laboratory will expand to address issues of training technology for specific military and industrial applications. In addition, the lab will examine questions of transfer of technologies that are more related to specific content areas than to training or education. For example, certain team performance techniques established through military contracts could be examined for transfer into factory settings.

For education in particular, the Lab has targeted specific areas as worthy of searching for additional funding in an effort to examine transfer of technology, modification of content, and re-purposing issues. These areas include:

- Distance Education and Interactive Television
- CAI / ICAI
- Expert Systems
- Interactive Video
- Simulations
- CD-ROM
- Learning Styles - Modalities - Preferences- Right/Left Brain
- Problem Solving

FACILITATORS

The transfer of technologies is a major issue of concern for faculty who work with the Institute for Simulation and Training, but it is also a topic of concern throughout the United States. No such topic of concern can progress toward some aspect of resolution without sources of financial and logistical support. The following sources of information represent the variety of support that has been identified for this effort.

FEDERAL PROJECTS

NSCCE

The National Science Center for Communications and Electronics at Fort Gordon, Georgia has identified the transfer of technologies from the military into the schools as one of its major functions.

Technology Transfer Act of 1988 and NTIS

This act of Congress identifies the importance of transferring appropriate technologies from government agencies into the public sector and establishes initial implementation guidelines. The National Technical Information Service will serve as a prime facilitator.

STATE PROJECTS

FHTIC

The Florida High Technology Industries Council has recognized the need for technology transfer and has funded the developmental project for the Technology Prototyping Laboratory.

Florida DOE Centers for Instructional Computing

The State of Florida Department of Education has assigned technology transfer related projects to several of its regional Centers for Instructional Computing.

LOCAL INITIATIVES

Industry Partnerships

Several industries have expressed interest in helping to support the transfer of technologies interests of the university. They are aware that in the long run improving the educational process will be a benefit to their activities.

Visiting Scholar Programs

Orlando has several "high technology" industries that create summer scholar positions for college faculty and K-12 teachers. These positions allow teachers and industrial workers to get to know each other much better.

SUMMARY

There are two related processes involved in getting new training technologies into the public schools. First, professionals on both sides must communicate sufficiently to understand each other's professional needs and goals. Second a vehicle must exist to facilitate the objective evaluation of new delivery systems and design techniques. At the University of Central Florida, the process has been designed around a Prototyping Laboratory concept through the Institute for Simulation and Training. This lab, by working with local, state, and national organizations, is in a position to promote this transfer of technology.

THE IMPACT OF HIGH TOUCH IN THE HIGH TECH WORLD OF EDUCATION: AN ISSUE REVISITED

R.M. Bollet and R.A. Cornell[*]

When last we left you in Edinburgh we covered multitudes of information within a scant fifteen minutes—both you and we were exhausted! Now we ask you, it this any way to encourage the use of "high touch" in this whirlwind of technocracy which surrounds us!

We believe sufficiently in our message that we opted for another go at delivering it—addressing the more critical issue of "How do we, as well as those we teach, cope with an ever increasing barrage of technostress?"

A number of options present themselves. All, however, revolve around one major individual—the learner! We'll state our "bottom line" now: We who work in the educational technologies have the responsibility to insure that our every effort is designed to produce a learning experience which is as humanistic as possible. Doing so, however, requires insight into both we who teach (self) and those learn (others)!

Indeed, the field of instructional technology is becoming increasingly aware that, along with all of its near-requisite "bells and whistles," there must be an accompanying responsibility to insure that human needs are addressed as well.

Author, humanist, computer guru, Ben Shneiderman, given the problem of technostress as it applies to the computer-user (which increasing numbers of us have become) states:

> Frustration and anxiety are a part of the daily life for many users of computerized information systems. They struggle to learn command language or menu selection systems that are supposed to help them to do their job. Some people encounter such serious cases of computer shock, terminal terror, or network neurosis that they avoid using computerized systems. These electronic-age maladies are growing more common; but help is on the way!
>
> ...the diverse use of computers in homes, offices, factories, hospitals, electric power control centers, hotels, banks, and so on is stimulating widespread interest in human factors issues. Human engineering, which is seen as the paint put on the end of a project, is now understood to be the steel frame on which the structure is built (Shneiderman, p.v., 1987).

If we are to speak to these "human engineering" needs we simply must learn more about the learner, who he or she is, and problems they currently face. Not to do so is pedagogically unsound but cruel as well.

The need to assess our learner's background, however, is predicated on the fact that, first, we must fit a professional profile which will facilitate our own entry into the realm of instructional design. In truth, it is simply not enough for us to adopt the code of "do as I say, not as I do." If there is to be a joining between instructor and instructee, there must first be some element of compatibility extant between the two.

What do we mean when we say this? We are saying, in as direct a way possible, that there are baseline personal attributes which the instructional designer should possess if he or she is to adequately pursue the design of materials for others. Kemp appears to say it best when he states:

> Not everyone can become and instructional designer. Just as the work of a medical doctor or that of an airline pilot requires that a person possess certain personal traits and act in certain ways, so there are personality factors and behavior patterns which can indicate whether or not an individual could engage successfully in instructional development work (Kemp, 1985, p. 206).

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[*] Robert Bollet and Richard Cornell, both Associate Professors in the Department of Educational Services at the University of Central Florida, are also consultants to the Center for Change, a non-profit educational foundation.

Following this statement, Kemp lists eleven traits which he deems important:

- Willingness to assume responsibilities and make decisions
- Enthusiasm, with a sense of commitment to one's work
- Patience, combined with the ability to avoid frustration
- Persistence in staying with a difficult problem
- Interest in handling many details and organizing them into meaningful patterns
- Integrity and honesty
- The maturity to put up with resistance, resentment, and even obstructionism
- Good sense of timing, to know when to act and when to remain silent
- Willingness to innovate and try new things
- Willingness to admit mistakes and ability to say, "I don't know (Kemp, p. 207, 1985).

Romiszowski, bridging our discussion of traits of the teacher/designer to those of the learner, examines the "missing domain" of the social, interpersonal, and interactive as applied to the act of designing instruction. He indicates that, when it comes to interactive skills for the educational technologist, two tendencies from the past have conspired to impede implementation.

One is proffered by the various entrepreneurs who, confronted with what Romiszowski calls the "undefined and unanalyzed area" [interactive skills], came forth with a variety of 'instant solutions', safe in the knowledge that it will be very difficult either to prove or disprove the effectiveness of their techniques.

We continue, for example, to be bombarded with innumerable brochures which announce that, if one attend this workshop, one will become expert in "resoling employee dissatisfaction" ... "managing internal corporate conflict" ... "effecting higher motivation levels among the work force" etc. etc...

Opposing the entrepreneur mind set is, Romiszowski states, the second tendency—"a rejection of the technique(s) [as above] and of all connected with it by the 'scientific community', meaning those who like to see all things measured and reject anything that cannot for the moment be measured (1981, p. 219)."

Romiszowski concludes:

> Thus there has been a tendency for educational technology to ignore the group dynamics movement and this has no doubt been helped by a philosophical polarization between the 'social education' supporters who are staunch believers in the process-oriented approach to education (and all that implies in the way of discovery approach to all learning), and the more dyed-in-the-wool educational technologists who want to have measurable products (objectives) defined for all learning and often find it hard to justify discovery methods on a cost-effectiveness basis (1981, p. 219).

We are left, then, with a polarity of opinion, even within our field, as to what might be the "best" pedagogical approach to take where designing materials in a 'humanistic' manner is concerned. One group most definitely would include such a concern, the other most likely would not, seeing such as being not cost-effective nor necessary. It is to those in the latter group towards which we direct this paper.

Obviously, our prime concerns are two-fold, that of the teacher and that of the learner. Assuming that we meet the Kemp criteria previously stated, and that we do plan our instructional design along the lines of Romiszowski's discovery approach to teaching, how do we access the concerns of the learner; how do we insure that what we know of the learner is also what is best included within the instructional design? One issue links to the other.

How can we possibly get to "know" our learners, you ask? There are a number of various tests, scales, surveys, etc, which can shed some light on this mystical identification process and tell us a great deal about who our learners are.

To name three— the Meyers Briggs provides considerable information about the style of person each of us is. So too, does the work of Dr. George Manning at Northern Kentucky with his instrument, "Chocolate, Vanilla, or Strawberry — Which are You?" A third instrument, one which we find most intriguing, was developed by Donald Lowery, Communication Companies International, Laguna Beach, California, and is named "True Colors". With the kind permission of CCI and Mr. Lowery, we have reproduced a few of its questions and in slide format, his "true colors" cards.

True Colors is taken from research done on the Myers Briggs Personality Type Indicator. Where the MBTI has a matrix of 16 types, True Colors reduces them to four general "color" types. Lowery indicates that most of us have at least one preferred "color" type of behavior and perhaps at least one secondary color. We are happiest and most content when allowed to operate from our preferred "color" mode of operandi. When the human organism is happy, content, in its preferred state, it will experience less stress and remain optimally operational. Therefore, using a format such as True Colors, may be one way to better understand our learner and keep him/her less stressed by high tech.

Now for a closer look at True Colors, let's do a little self-examining by trying to discover what each of us has as a "primary color". To do this, we will ask you to look at each of four areas and pick the one which most accurately represents how you like to learn.

#1 is the "GOLD COLOR — PRACTICAL STYLE LEARNER". GOLD LEARNERS which make up approximately 38% of the population...

- Likes structure and routine
- Needs clear step-by-step directions.
- Needs a stable, organized teacher.
- Likes the teacher to be specific and consistent.
- Likes an assigned seat.
- Wants to please the teacher.
- Is uncomfortable if not prepared.
- Is obedient and conscientious.
- Learns best using concrete facts.
- Needs direct, concrete experiences.
- Likes question and answer sessions.
- Needs time to think before answering.
- Needs to be taught symbols directly, slowly , and clearly.
- Can handle symbols well when they are specifically explained.
- Prefers TV to reading.
- Chooses "factual" kinds of stories.
- Asks "What" questions.

#2 is the "ORANGE COLOR — ACTIVE STYLE LEARNER". ORANGE LEARNERS which make up approximately 38% of the population...

- Must be active in order to learn.
- Needs freedom.
- The traditional classroom prevents this style from learning.
- Often considered slow — like Thomas Edison.
- Rebels against supervision.
- Wants to work in own way.
- Finds paper and pencil work deadly.
- Loves to use all kinds of tools.
- Often finds symbols confusing and gives up learning them.
- Needs their significance explained and taught directly & slowly.
- Reading and arithmetic must be related to doing something.
- Is spontaneous, competitive, resourceful.
- Can be a top athlete, musician or craftsman.
- Stays at a task at length when interested.
- Needs appreciation of abilities and suggestions for channeling them.
- Asks "How does this work?" questions.

#3 is the "BLUE COLOR — PERSONAL STYLE LEARNER". BLUE LEARNERS which make up 12% of the population...

- Adapts to the traditional classroom if the teacher is friendly & warm.
- 36% of the teachers are this style.
- Achieves unless turned away by a critical, negative climate.
- Hypersensitive to conflict or rejection.
- Can become physically ill from too much criticism or negative input.
- Needs personal, positive feedback.

- Sees the report card as a personal judgement of self.
- Focuses on people more than on things.
- Has a vivid imagination and deep sensitivity.
- Is idealistic, friendly, understanding.
- Usually reads well, like myths, fairy tales, social studies.
- Usually does best in liberal arts subjects.
- Participates well in a group.
- Likes discussion and role-playing.
- Prefers cooperation to competition.
- Asks "Who" and "why" questions.

#4 is the "GREEN COLOR — FOCUSED STYLE LEARNER." GREEN LEARNERS which make up 12% of the population...

- Can conform but often tunes out traditional classrooms.
- Sometimes finds a mentor.
- An independent learner who pursues a goal until satisfied.
- Values intellectual abilities most.
- Needs to know and needs to be competent.
- Sets own tasks of what should be known.
- Often ignores other subjects in the process.
- Can seem to be an underachiever in school.
- May be regarded by teachers a cynical, arrogant or condescending.
- Not too concerned about what teachers think.
- Wants a logical presentation.
- Often prefers math, science, technology.
- Can be a loner; may lack social skills and seem to be a snob.,
- Can seem cold, unfeeling, behind a wall.
- Needs help in setting realistic goals.
- Usually bends to parents and teachers' demands.
- Asks "Why" and "How" questions.

Now which "COLOR TYPE" is most like you? Of course there will be exceptions and not all characteristics will be appropriate but which "COLOR TYPE" is most similar to your preferred style of learning? Then decide which one is second, third, and least like your preferred style of learning.

By understanding one's preferred style and attempting to design learning activities which allow our learners the freedom to use their preferred style of learning, potential stress and uneasiness will be greatly reduced. These "high touch" factors are important to keep in mind as we continue to develop "high tech" curricula. Designing materials geared toward the users preferences will better insure decreased burn-out and higher productivity.

CONCLUSION

We cannot turn back the hands of time, albeit, some of use might wish to. We cannot bury our heads in the collectivity of multiple sand piles and hope that all of this technology stuff will just go away. (We're sure that, at least for this group, such is far from the case!)

What each of us can do, however, is to rejoice in the knowledge that the world our learners might experience from this day forward, may well be one in which the "high touch" of humanity and compassion will take its rightful place beside that of technology in education and that both will emerge the better for having done so.

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A COMPARISON OF "ONE-TO-A-COMPUTER" TO "TWO-TO-A-COMPUTER" IN APPLICATIONS TRAINING USING MICROSOFT *WORKS*: A PROJECT REPORT

N. Bell[1]

ABSTRACT

With the increasing inclusion of computers in the teaching/learning settings, it became apparent that there was a need for studies related to the determination of the effects of presenting instruction concerning computer applications with more than one student assigned to each computer. It seems that when asked concerning the number of students assigned to a computer, most instructors indicate that the most advantageous ratio is 1:1, and that beyond that ratio, the effectiveness of instruction is reduced. Consequently a study was undertaken in which one section of a university course on computer applications had the ratio established at 1:1 while a second section of that same course had the ratio established at 2:1. In a pilot study, data were collected concerning student achievement and attitude, as well as detailed summaries of instructor activities in the two settings. No differences were found in student attitude and achievement. However, there were marked differences between the two groups with respect to the instructor's activities.

INTRODUCTION

In designing laboratories in the schools in which microcomputers are to be installed, the question often arises with regard to the ratio of students to computers. It appears that the initial answer to the question of the student-to-computer ratio consistently favors one student per computer. However, it also appears that because of the effects of other variables, there might be situations in which it would be more effective and efficient to have more than one student at each computer. If the effectiveness of grouping students at computers could be verified for certain courses, schools could then schedule at least twice as many students to a section and thus make more cost-effective use of the microcomputing facilities.

THE SETTING FOR THE PROJECT

Through the past ten years in the computer laboratory in the College of Education at Michigan State University there has been a variety of computers used for the purpose of providing instruction to pre-service and in-service teachers and administrators. The laboratory in the past has been supplied with Apple II's, Atari 800's, Radio Shack Model 1's, Radio Shack Color Computers, and until recently a combination of 11 Tandy 1000's and 11 Apple IIe's. In that equipment configuration, there were then 20 computers for use by students and 2 computers placed in the front of the room for use by the instructors. With the laboratory so equipped, the maximum class size had been established at 20 students. Even though it would appear that there was a one-to-one ratio, in reality there was a two-to-one ratio, since none of the applications programs being used in the courses operated on both types of machines.

Then, a change in the equipment was made in which the Apple IIe's were replaced by an additional 10 Tandy 1000's, and all 21 Tandy's were equipped with the TrackStar board, making them able to run both the MS-DOS software and the Apple II software. With this new configuration of equipment, it became possible to have a one-to-one ratio of students to computers for the applications courses, since there were twenty student workstations with identical capabilities. Being able to begin the new term with the additional equipment caused the instructors of the various applications courses to look forward to progressing more rapidly and perhaps being able to then teach the applications more in depth. A few weeks into the new term, however, through discussions with several of the instructors, it was determined that one common experience across the various courses was that the instructors were required to provide more individual help than had been previously experienced in the same courses with what appeared to be very similar students. Thus, the stimulus arose for a project to compare teaching with two students to a machine to teaching with one student to a machine.

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DESIGN OF THE PROJECT

Because, for the Autumn Term, 1988, two sections of the introductory applications course had been assigned to the researcher, it was possible to control the enrollments in such a way as to allow twenty students in one section and forty students in the other. The course was an introductory course in computer applications entitled, *Computers in the Classroom.* The general topics of the course are as follows:

- Introduction to the Microcomputer
- Methods of Developing Keyboarding Skills
- Introductions to Word Processing, Electronic Spreadsheets, and Data Management and their Instructional Applications
- Introduction to the Programming Process and Structured Programming
- Computer-Assisted Instruction
- Instructional Applications of Telecommunications
- Instructional Applications of Desktop Publishing
- The Use of Teacher Utility Programs
- The Future of Computers in the Instructional Setting

The general operation of the course included presentations by the instructor during which time hands-on activities were being conducted by the students. For each of the applications there was a brief introduction by the instructor, during which the students would be given specific instructions with respect to the application. In this initial portion of the instruction, there would be a major amount of time devoted to manipulating existing files. For example, in the word processing segment of the course, the instructor would have provided on diskette a variety of text files, and the students would make changes to these files by inserting, deleting, exchanging, formatting, and keying in additional text information. The instructor would lead the students through these changes, step-by-step, with the students making the changes and noting the results.

Following this instructor-oriented presentation, the students would be given activities, the first of which was very similar to the large group activity. Additional activities would include the creating of files to produce output designed by the instructor. Finally the students would then be requested to create their own files, that is, files to produce output designed by the student. In this instructional setting it is obvious that there is a maximum of use of the computers during the formal course time. In addition, the students were then required to use the lab several hours during the week to complete individual assignments.

For purposes of the project, it was assumed that because for each of the two groups, the one-to-one group and the two-to-one group, there would be twenty workstations available for use, no more than twenty requests for assistance could be generated at any one time. There were only twenty computers with which something could go wrong. So in hypothesizing differences between the two groups, it was felt that no differences in the frequency count would be expected. However, it was also felt that for the class with two students at each computer there was a real possibility that the students at any one workstation could help each other and thus not request assistance from the instructor. Past experience in the course indicated that students working one to a machine were not as likely to disturb a colleague at an adjacent machine, since quite often it appeared that the colleague was hard at work and did not wish to be disturbed. Also there appeared to be the possibility of the stigma of not having listened well enough to the instructor's presentation, or even not being capable enough to operate either the hardware or the software. Thus, the assumption that if there were two at a workstation, they would naturally work together to at least keep up with the students at adjacent stations, and would be very likely to be able to fill in the gaps in information for each other. Consequently, it was expected that in the class with two students to a computer there would be fewer requests made to the instructor to come to the workstation and help them with any particular hardware or software problem.

THE PILOT STUDY

During the Autumn Quarter, 1988, the pilot study was undertaken. For purposes of the study the two sections were taught using exactly the same instructional materials. In fact, the two sections were scheduled the same day, the one-to-one section from 3-6 PM and the two-to-one section from 7-10 PM. In order to be able to teach the sections and concurrently collect data, a laptop computer was programmed to serve as a data collection device. The computer, a Tandy 102, was then carried to the workstation, and as soon as the type of difficulty determined, data concerning the type were entered into the laptop. Thus the laptop had stored in it not only the frequency of instructor calls, but the type of call. A habit was thus formed by the instructor to pick up the 102 each time it was necessary to go to a student workstation to assist with a problem. This data collection system was easily used and proved to be a time-saver in terms of data collection. In addition, such use of a computer demonstrated to the students one more application of the computer in the classroom setting.

INITIAL RESULTS OF THE PILOT STUDY

At the time of writing, the data from the pilot study have only been collected and only briefly reviewed. These data include the information collected using the laptop, the results of the midterm and the final examinations, and responses to a survey concerning attitude toward the course, the delivery of the course, and an assessment of the instructor. A preliminary review of the data collected with the laptop indicates that there were far fewer requests for the instructor to go to an individual workstation in the class with two-to-a-computer. The data show that the instructor had to go to the workstations only approximately one-third as many times in the two-to-a-computer class. It appears that the reasons for being called to the workstations were similar in both classes. A cursory examination of the testing data has indicated no differences between the two groups, and a review of the survey data seems to indicate a similar conclusion. Thus, it appears that for this introductory course, two-to-a-computer is just as effective in terms of student behavior, but far more effective in terms of instructor behavior.

ANECDOTAL DATA COLLECTED IN PILOT STUDY

During the brief time between the two classes, and following the completion of the second class, it was possible to make notes concerning unusual responses in the two settings. Because the first class was the one-to-one class, and because the instructor was more frequently asked to provide individual help at the workstation, in the second class the instructor would know when to expect to be called on for assistance. Repeatedly during the second class the instructor would hesitate, waiting for the same requests for assistance which experienced in the first class. Most of these hesitations were not followed by requests for assistance. Quite often in the second class, a hand would go up, and the instructor would begin to go to the workstation, and then the student would call out saying that help was not needed. There were many such abortive attempts at providing individual assistance.

A second item of note was the shifting of students within pairs in the second class. It appears that the students realized that they could help each other, and during the initial class sessions seemed to check out the other students so as to be able to be paired with one that seemed to know more of what was going on than they felt they did. Because this was a rather unexpected outcome, no data were collected during the pilot concerning this process of selective seating.

Further, there seemed to be a very different attitude in the two-to-a-computer class. Obviously with forty students in the classroom there was expected to be more noise, but the great fluctuations in the noise level were not expected. During the instructor presentations, the two classes appeared to have approximately the same noise level. But during the hands-on periods, even when they were only one or two minutes in duration, the noise level of the two-to-a-computer class really picked up. In the one-to-a-computer class the noise level appeared to be constant between the instructor presentation and the hands-on periods. In fact, in the one-to-a-computer class, there was almost no sound other than machine sounds during the hands-on periods. Again no objective data were collected concerning noise levels in the two sections.

THE FORMAL STUDY

For a variety of reasons it has been decided to conduct a formal study comparing these two ratios of students to computers. First of all, because of what was learned through the pilot study, a second study will be much easier to conduct and can be made more accurate with respect to data collection. Secondly, because of the fact that in the pilot study the two-to-a-computer group followed the one-to-a-computer group, there was the problem of the instructor becoming more aware of potential student difficulties, and unconsciously emphasizing certain information which would allow the two-to-a-computer groups to be more successful. Thus, in the formal study, the groups will be reversed, and the experience gained by the instructor should then favor the one-to-a-computer group.

Probably the most pressing reason to conduct a formal study is related to scheduling and instructor load. If it is accurate to say that in introductory courses the learning is not negatively affected by having two students to a computer, and if the effort in the classroom which is expended by the instructor is markedly reduced, then there would appear to be reason enough to double the class size in such courses. Obviously there is another side to that coin. During times of grading, both at the midterm and at the final, the instructor had twice the work to do to produce the grades. Reading twice as many papers takes twice as long, and causes the instructor to work very hard during what are normally very busy times. However, it would appear that by having savings of effort offered during all class sessions, the extra burden of grading more papers is more than offset. Further, if through such a plan the students learn to work in a cooperative manner with each other, there would appear to be too much payoff for both students and the instructor to not opt for the two-students-to-a-computer arrangement.

The effectiveness of such an arrangement should not be a surprise, since centuries ago the writer of Ecclesiastes indicted that ". . .two are better than one, because they have good return for their work. If one falls down, his friend can help him up . . ." Further, the writer of Ecclesiastes may be providing direction for an additional study, in that he says "A cord of three strands is not quickly broken." Thus, for some instructional goals it would appear that the illusive goal of one-student-to-a-computer may be a goal that really should not be attained, at least for the sake of the instructor.

CURRICULAR APPLICATIONS OF TOOL SOFTWARE (CATS)

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ABSTRACT

The provision of hardware and software is not enough to ensure a meaningful implementation of a Computer Across The Curriculum policy. Assisting and supporting teachers and students in the integration of information technology requires both leadership and resources. CATS is the keyword - Curricular Applications of Tool Software is the product, in a resource development project undertaken by the North York Board of Education in Ontario, Canada. These units of study for students from grade 5 to grade 12 cover a wide variety of subject areas. The units are curriculum-based and employ the computer as a tool in support of the various student activities. Databases, spreadsheets, music processors, and desktop publishing are put to work in science, social studies, history, geography, economics, biology, outdoor education, and creative arts. The units contain teacher guidesheets, and datafiles and templates for different computers and programs.

INTRODUCTION

In many elementary and secondary classroom teachers and students have been experimenting with microcomputers to enhance learning activities. The initial emphasis on computer literacy skills and computer assisted instruction programs has switched to the use of computers as tools. In many cases this involves the use of integrated information processing software. Databases word processing, spreadsheets, charting and drawing programs, idea processing, desktop publishing and sound composition programs are used to enhance the curricular studies in many subject areas. To support the integration of these tools into the teaching strategies available to staff the North York Board of Education in Ontario, Canada has developed a series of curriculum units which provide lesson plans, datafiles, student activity sheets, and other support materials.

Over the past three years the process of this development process and evolved into a highly sophisticated state. A steering committee of representatives from different subject disciplines shares in guiding the production process. The nine stages of this production process are monitored by members of the steering committee. They also sponsor curriculum units through the entire production process. Unit authors propose development ideas and are compensated for the field-testing draft of the material. Implementation of these units includes inservice workshops for teachers. This process is a dynamic one which incorporates new elements as they evolve.

The units cover a variety of topics in different subject areas and at different grade levels. Databases units have been developed for science, history, geography, mathematics, outdoor education, physical education, and language arts. Spreadsheets have been applied to topics in economics, history, geography, mathematics, science, and computer studies. Other units integrate idea processing software and desktop publishing in history, economics and science. Units currently underdevelopment use the power of the Hypercard environment to link databases to video disk slides and movies. Technical tips have been produced to lend skill support to each of the software packages.

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THE PROCESS

Nine stages have been identified in the development process. Each of these stages has at least one member of the steering committee who is responsible managing the progress of each unit. Another member of the steering committee is responsible for the sponsorship and coaching of the authors of a particular unit through all of the stages. The nine stages are outlined below.

Review Stage 1

At this stage existing curricular materials are examined to determine topics which are likely to be enhanced through the use of tool software. Curricular links are established to Ministry of Education documents and local school board course outlines. The endorsement of curriculum specialists or subject coordinators is sought. Potential writers are identified from among subject committees and computer using educators. The curricular hooks are established and the links thus created will be taken advantage of later in the process.

Development Stage 1

The development begins with the formal identification of unit writers. A project monitor from the steering committee is appointed. A written unit proposal is developed by the monitor and writers. This proposal contains reference to the proposed topic, the target student group, the curricular area, a rationale stating why the use of tool software would be beneficial, unit aims and objectives, prerequisite skills, concepts and attitudes, the hardware and peripherals required, an outline of the student activities, an overview of the teacher support sections, and a timeline for the completion of the project. The project monitor works with the Development Stage 1 coordinator(s) to negotiate a formal contract with the writers. The compensation received by the unit writers could combine any of release time for writing, leiu time release for summer writing, financial considerations, or royalties for sales beyond the board. Authors are provided with hardware and software to complete the writing of the unit.

Development Stage 2

This stage sees the training of the authors in use of desktop publishing software, and an orientation of the writers to the guidelines and expectations for CATS units. Language usage and style guidelines are provided. Samples of other units are available for authors to emulate and yet differ from to the extent that their creativity will allow. The authors are introduced to standardized student support materials. Authors begin by developing a flow chart of the potential activity to be included. The unit monitor provides feedback to the writers in guiding them through this early draft.

Development Stage 3

The first draft of the unit is completed in this stage. It is polished and ready for field testing. Data disk(s), if required, accompany the submission. The coordinator of this stage is now responsible for the editing of the unit for language and layout considerations. Prior to field testing the unit is vetted by subject specialists and a committee responsible for examining board documents for bias. A field test is designed complete with an appropriate evaluation procedure. Field test draft units are produced. Field tester are selected. The field test is completed. A report of the results of this is prepared for the steering committee and the authors.

Development Stage 4

Recommendations from the field test report are considered in determining exactly to what extent the unit will have to be revised. A new contract is established either with the original authors or a rewrite team to complete the revision. A final editing of the revised unit takes place. If necessary a separate contract may be let to enhance the layout with such things as graphics. A cover design is determined. This stage ends with a camera-ready copy.

Development Stage 5

Unit production is the focus of this stage. The unit documentation is printed. Disks are duplicated and appropriate labels created. The packaging of the materials is refined including bindings where necessary.

Implementation Stage 1

The implementation begins with the introduction of the unit to the school system. Announcements and the distribution of initial copies of the units take place at meetings of administrative and field support staff. Workshops are planned through which classroom staff are introduced to the rationale and activities of the units. Additional workshops are provided for staff unfamiliar with the type of tool software involved. An example of this would be introductory workshop about database concepts and keyboard commands. These workshops are advertised and delivered centrally initially.

Implementation Stage 2

On-going support for the units is also provided. The materials are distributed to interested staff. More specialized workshops for school staffs, staffs of families of schools or subject organizations are also arrange. In-class support for teachers is provided by program leaders, school department chairs, and subject coordinators. The published units are warehoused centrally and are available to all staff and interested parties external to the board.

Review Stage 2

The completed units experience an ongoing review of the relevance of the activities for the topic and the appropriateness of the tool software employed. Tool software is evolving very quickly and units can often be improved to take advantage of significant advances. in software design During this review process new ideas are often identified for supplemental units.

This nine stage process is a dynamic one that has evolved over three years of experiences working with the CATS steering committee and many groups of authors.

THE UNITS

Existing CATS units are described below in groupings according to the type of tool software employed.

Let's Choose a Place to Live in Southern Ontario

This unit written for the grade nine and ten geography student combines student decision making skills through the analysis of statistical data via the manipulation of data in a database and spreadsheet. Teams of students are given background information about a family trying to decide which city to move to in Southern Ontario. This background outlines the needs and wants of the family members with regard to characteristics of a location. The students manipulate data about such things as crime rates, housing costs, hospital beds, and recreational facilities to help in the decision process. Weighting factors are given to the various catagories based upon the desires of the adopted family. This unit has applicability in many subject area providing applications of skills in the areas of mathematics, communications, and guidance.

The Graveyard Study

In this grade seven unit students gather data at a local cemetery. The students develop a plan by which they will act as historians in deciding which is the relevant data that can be found on tombstones. A Data collection method is arrived at by student teams. A values clarification exercise is conducted prior to the visit to the cemetery. The students gather samples of the possible data found. Data from the various student teams is merge in a single class database. The students then examine the information contained. Searching and sorting techniques are mastered as the data is explored. Generalizations are formed and tested in this database investigation. Problem solving and communications skills are employed in the extensions of this unit.

Survey of the Invertebrates

The classification systems of biology are explored in this grade eleven unit. Searching and sorting skills are developed as students manipulate the information in a supplied database. Extensions of this unit may employ the use of large databases of both textual, auditory and visual material found on Videodisks.

Summer Olympics

This unit was prepared for the Summer Olympic Games held in Korea in September of 1988. It provided students with a database of the results of the track and field events held in the modern olympic games. Student activities included investigations of one event in depth and recording of the results of the current games. Trivia contests were held in which the students were required to search for and sort the information contained in the database to arrive at accurate answers. This topical unit was enjoyed by students in grades four through twelve.

Spreadsheet Solutions

This is a collection of short (two to ten hour) modules through which students in the junior, intermediate and senior division explore the application of spreadsheet skills to curricular investigations. This cross discipline collection includes activities in physical education, history, economics, family studies, science, geography, and mathematics.

Triangulation Mapping

In this unit students employ both a spreadsheet program and a drawing program to make accurate scale sketch maps of a local site. Students measure the length of a base line. They then take compass readings from both ends of the base line to selected objects that can be viewed such as buildings, trees, flagpoles, or outhouses. This data is entered into a spreadsheet template. An appropriate map scale is decided upon and entered in to the template. A printed output of the spreadsheet provides students with a coordinate location for each of the selected objects. This information is then used to locate student created symbols on a map using a painting program.

Let's Go Fly a Kite!

Making and flying kites holds a fascination for children of all ages. Scientific investigations of the changes made in the magnitudes of such things as the weight, tail length, width, or area of a given kite design are enhanced through the use of a spreadsheet template. These factors are analyzed with the goal of determining which factors most influence how high the kite will fly, how acrobatically it will fly, or how they will influence the tension in the kite string. Hypotheses are developed and tested through hands-on construction and spreadsheet analysis.

Other units involve primary students building a database using stuffed toy animals, weather data collection and analysis, an ecosystems database, an idea processor used in conjunction with historical investigation, and the analysis of data available through sports halls of fame such as that found in Cooperstown. New units are in the planning stages now. Much excitement among teachers and enthusiasm among students has been a side effect of the tool use of computers in curricular applications.

IT "WORKS": NETWORKED TEACHERS, NETWORKED STUDENTS

G. A. Carnow*

ABSTRACT

Networked versions of Microsoft Works were placed in Alhambra High School in the Spring of 1989. Alhambra High is a multi-ethnic high school, with over 3200 students in grades 9 to 12, near downtown Los Angeles. Alhambra is part of the Model Technology Schools Project, funded by the State of California to show how students and teachers in California schools can implement mandated curriculum frameworks in a technological setting. The approach is student-centered, using technology as a tool. Microsoft Works was selected as a component of this project because it combines four "tool" applications in one easy-to-use program.

Students used a lab of Tandy 1000s with a VELAN network; teachers used a network of PCs. Every science and math classroom has a PC, large monitor, and network access to courseware and Microsoft Works.

The paper presented at the conference will describe our experiences. In particular:
How did students use Microsoft Works in business education classes?
How did teachers use Microsoft Works?
What training was required to learn the program?
What steps were required to implement the two networks?
Where should we go from here?

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NEW TECHNOLOGIES FOR FLORIDA EDUCATORS

Donna Baumbach*, Anne Barron#, Gary Orwig‡

ABSTRACT

One of three centers funded by the Florida Department of Education, the UCF/DOE Instructional Computing Resource Center is housed at the University of Central Florida in Orlando. The Center has been providing information to Florida educators about computers and computer literacy for several years and has recently undertaken a project designed to introduce Florida educators to new and emerging technologies for instruction and information management. This paper describes the need for the project, the development of various phases of the project, and the products and reports resulting from the project.

INTRODUCTION

New technologies for instruction and information management continue to emerge, and with these innovations comes a need for educators to be informed about them. This was true with the advent of motion pictures and educational television and continues to be true with video cameras and computers. Educators at all levels find it difficult to keep up with new materials and media. Staff development and inservice programs are offered, and educators can read professional journals and attend conferences. But while such methods can provide needed information on new trends and teaching techniques, the rapid introduction and refinement of new technologies makes it difficult to keep pace.

The Florida Department of Education Office of Educational Technology has funded three "satellite" centers to assist educators who are seeking information about new and emerging technologies. While all three centers have similar charges and operate under a single advisory board, each center has a unique role assigned to it as well. The Florida Center for Instructional Computing is housed at the University of South Florida in Tampa and is primarily responsible for reviewing instructional computing software and issuing the results of those reviews to educators through an on-line database and hardcopy. The Broward County Satellite Center is located at the School Board of Broward County in Davie and focuses its efforts on staff development activities. The UCF/DOE Instructional Computing Resource Center concentrates its efforts on computer literacy.

THE UCF/DOE INSTRUCTIONAL COMPUTING RESOURCE CENTER

The UCF Center was established at the University of Central Florida in Orlando approximately six years ago. Early efforts centered around providing information about computer literacy efforts in this state and other states. The Center provided instructional materials for the state's minimum student performance standards in computer literacy to all schools in the state, and a videotape introducing the standards to teachers was also developed. The Center provides information through newsletters, workshops, telephone consultation, electronic bulletin board and mail service, and a preview center for computer software and hardware.

The Center works through an established "Instructional Computing Contact Network" (ICCs) comprised of one key person in every Florida school district, community college, college of education, exceptional education center, and the Centers for Excellence in Science, Mathematics and Computer Technology. All materials and information are provided directly to these contacts who then selectively disseminate them to appropriate individuals in their own districts or institutions. For example, while the Center is not funded to provide newsletters to every teacher in Florida, camera-ready copy of the newsletters are distributed to the ICCs. In some districts, the newsletters are reproduced for every teacher. In other districts, the newsletter is sent only to

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school level computer contacts. In still other districts items from the UCF newsletter are added to the district newsletter.

SURVEY PURPOSES AND RESULTS

In 1988, the UCF/DOE Instructional Computing Resource Center broadened its mission from providing information about computers and computer literacy to include the whole range of educational technologies with particular emphasis on optical storage devices and emerging technologies. A survey was conducted of the Florida Instructional Computing Contacts and district media supervisors to determine the status of three new technologies for instruction and information management: CD-ROM, video disc, and hypermedia. In addition to determining what currently exists in the schools, school districts and community colleges, contacts were queried as to what kinds of information and services they would find helpful related to the new technologies.

The results indicated that all three technologies are for the most part being used in select locations on an experimental basis. While there is some use of all three technologies, there is not widespread use of any one. The survey revealed that school level educators are less aware of the technologies than media and instructional computing contacts, and that a great deal of information and training is necessary if the innovations are to be adopted.

CD-ROM is the most popular of these technologies in Florida where it is currently used in several different ways. CD-ROM is primarily used at the district level, where large databases are used to assist in library media acquisition and processing. In several districts, CD-ROM technology serves to hold the massive number of lessons required by integrated learning systems. Finally, in very limited numbers, CD-ROM resources are used in community college libraries and school media centers for research and reference.

Video disc technology is less well established in Florida schools. Video discs are used in community colleges to teach computer literacy and in adult education to provide basic literacy skills. The uses of video disc tend to be concentrated in math and science on the secondary level, but generally the contacts seem to indicate that they are waiting to see if pilot programs are successful before investing in the technology.

Most of the ICCs were unaware of the use of hypermedia to any extent in their institutions. Many reported being unaware of hypermedia and its applications even at the district/institution level, and most contacts were convinced that their constituents knew little if anything about the technology.

The results of the survey indicated a need for general information about new and emerging technologies for teachers, media specialists and administrators. They felt that hands-on workshops that provided experiences with the new technologies would be important, too, as would the sharing of ideas for utilization and integration. Most also felt that in order to make wise purchases, previews and/or reviews of hardware and commercial titles in all three area are necessary.

Because special hardware is required for CD-ROM, video disc and, to some extent, hypermedia, it is difficult for Florida educators and to preview these materials. National professional associations such as the Association for Educational Communications and Technology (AECT) and the American Library Association (ALA) and others have had exhibits that feature new technologies. Unfortunately few teachers attend such national conferences. The state of Florida's annual instructional computing conference has had few presentation sessions or exhibits featuring these new technologies, and while this is the largest technology conference in the state, only a fraction of the state's educators can attend.

NEW TECHNOLOGIES BROCHURES

In order to reach a large number of educators quickly and inexpensively, a series of brochures on new technologies was designed, developed and distributed through the Instructional Computing Contact Network and at the Florida Instructional Computing Conference. There are six brochures in the series: CD-ROM, laser video disc, interactive video (2), hypermedia, and artificial intelligence.

Because of constraints in faculty time, equipment and facilities, the brochures were produced in a rather unique fashion. Text for the brochures was written with a word processing program on an MS-DOS machine at one faculty member's home, uploaded to the bulletin board of the UCF Instructional Technology program, and downloaded to, edited, revised and formatted on a Macintosh computer. A page layout program was used to combine clip-art graphics and text into a tri-fold brochure format, and the pages were printed on a laser printer. Offset printing provided high quality copies for distribution in both camera-ready and finished form.

The brochures address questions that educators might ask about the new technologies including what each is, what advantages and disadvantages currently exist, how it might be applied to educational settings, general cost, and related vocabulary. Written in a conversational tone, the "What Every Educator Needs to Know about the New Technologies" series can be reproduced quickly and inexpensively by school districts and institutions.

COMPUTER BASED EDUCATION PROGRAM ABOUT CD-ROM

While hands-on experiences cannot be provided for every teacher due to the need for specialized equipment, simulations can be designed and implemented at school-based sites. The first product introduced was a computer-based education program (CBE). CBE was selected because it adapts well to a wide range of learner characteristics and allows for individual sequencing, self-paced instruction, and immediate feedback. The program was designed for use by educators as well as students in grades seven and above.

The CD-ROM tutorial program is divided into four major categories, which are the Main Menu choices (see Figure 1). Students may choose the Main Menu selections in any order, repeat them if they wish, and exit at any time. Throughout the program maximum learner control is provided with permanent options such as Back, Exit, Return to Menu, and Continue.

The "Overview of CD-ROM" section defines CD-ROM technology, illustrates the required configuration, and provides an explanation of how CD-ROM discs are read. The "Search Strategies" section addresses techniques used to search for and retrieve information. The techniques demonstrated (logical connectors, wildcards, and proximity searches) are used in CD-ROM applications and are also applied to on-line information retrieval. The third section provides a simulation of the CD-ROM Grolier™ Electronic Encyclopedia. It is designed to acquaint the learner with the operation and features of the Grolier CD-ROM and to provide an opportunity for the student to experience a CD-ROM application without the necessary hardware. The student can choose to Browse or perform a Word Search for the word PANDA. The final "CD-ROM Applications" section includes a listing of the names and subject areas of several of the available CD-ROM applications. The address and telephone number of the publisher are also provided for those seeking further information.

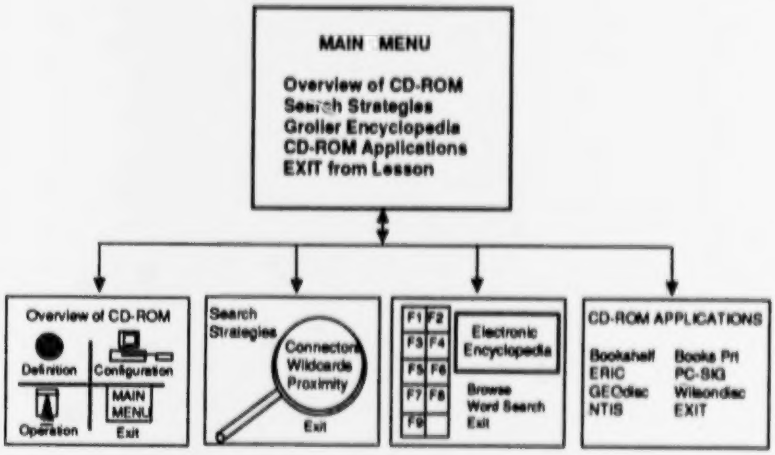
MAIN MENU
Overview of CD-ROM
Search Strategies
Grolier Encyclopedia
CD-ROM Applications
EXIT from Lesson
Overview of CD-ROM
Definition
Configuration
Operation
MAIN MENU
Exit
Search Strategies
Connectors
Wildcards
Proximity
Exit
F1
F2
F3
F4
F5
F6
F7
F8
F9
Electronic Encyclopedia
Browse
Word Search
Exit
CD-ROM APPLICATIONS
Bookshelf
ERIC
GEOdisc
NTIS
Books Prt
PC-SIG
Wilsondisc
EXIT

Figure 1. Main Menu of CD-ROM Tutorial

The course was developed for delivery on an IBM® or compatible computer because most of the CD-ROM products are configured for MS-DOS® environments. A Macintosh HyperCard™ version and an Apple® // version based upon this original design but substituting applications specific to each system are under development. The authoring system chosen for development was the TenCORE® Authoring Language by Computer Teaching Corporation. TenCORE provides the required windowing capabilities, flexibility, response analysis, and graphics. A minimum of a color graphics adaptor (CGA) card is required with a color monitor and 256K random access memory.

The effectiveness of the CD-ROM tutorial was evaluated by students at the University of Central Florida with a criterion-referenced pretest and posttest. The results indicate that there was a significant increase between pretest and posttest scores for the group receiving the treatment.

The program has been distributed by the Center through the Instructional Computing Contact Network. It may be copied for educational use in Florida schools.

PREVIEW AND REVIEW ACTIVITIES

While the Center has long been used as a center for previewing educational software, educators are now able to visit UCF and preview CD-ROM, video disc, interactive video, hypermedia, expert systems, and authoring programs as well as a variety of hardware related to these materials. The center will continue to inform Florida educators by developing criteria for evaluating commercial products in these areas and will issue reports via the Florida Information Resources Network (FIRN)—the state's on-line network—and via hardcopy to the ICCs. The reports will include potential applications, connectivity, compatibility, and item specifications for purchasing materials. The Center has been successful in working with commercial producers and publishers who have provided workstations and materials for preview.

The UCF/DOE Instructional Computing Resource Center will continue to provide services and materials to inform Florida educators about new and emerging technologies for instruction and information management. This paper has described several recent and current projects which have been successful in this state.

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TenCORE is a registered trademark of the Computer Teaching Corporation.
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Macintosh and Apple are registered trademarks of Apple Computer, Inc.
HyperCard is a trademark of Apple Computer, Inc.

A STAFF DEVELOPMENT APPROACH FOR COMPUTER INTEGRATION

G.J.Carleer, J.J.H.van den Akker, J.B.H.van Diggele * .

ABSTRACT

Within the framework of the Dutch national policy for the integration of computers in education, a cooperative R&D-project is being carried out by two pilot schools (secondary education, grades 7-12) and a team of researchers.

Based on the results of an analysis of experiences and current practice on computer use in the two pilot schools and findings from research literature on teacher training, a plan for inservice training at the school-building level has been developed. The emphasis is on the training of teachers within the same subject area. This training consists of five steps: orientation to and selection of courseware; hands-on experience with this courseware; development of an instructional unit in which courseware integration is realized; execution and observation by colleagues of this unit; reflection and revision.

The aim of the training is twofold:

- improving the skills and confidence of individual teachers in computer use,
- stimulating the interaction between teachers in exploring and realizing computer integration in their teaching practice.

CONTEXT

A few years ago the Dutch Minister of Education and Science started the project, New Information Technology in Secondary Education. One of its objectives was to place at the disposal of each secondary school in the Netherlands eight MS-Dos computers. Although it was clear that eight computers for one school was a very small number with which to promote an intensive use of computers in the schools, the available budget set this restriction. However, in order to explore the possibilities of the use of computers in a technology-enriched environment, the Minister started the Experimental Schools Project (ESP). This R&D-project is being carried out by two pilot schools for non-vocational secondary education (Grades 7-12) and a team of researchers from the University of Twente. One school consists of about 1000 students and 71 teachers, the other school comprises about 1700 students and 98 teachers. Both are city schools with a great interest in computer use and some enthusiatic teachers, but with an average computer use. The schools are now equipped with 30 computers each, spread over two computer classrooms, and receive funding for approximately 1200 hours of released time for teachers participating in the project. A comparable project is being carried out by researchers from the University of Amsterdam in collaboration with one school.

The aim of the ESP is to investigate various ways of realizing computer integration in the two pilot schools.The relevance of the ESP consists of the possibility to explore at the present time the educational use of computers in a school context that can be expected to be similar to a normal school context in about five to ten years in the future. The experiences of the pilot schools and the results of the research of the ESP will be made available to other schools, so that at the proper time the large-scale use of computers will be facilitated.

This paper deals with COMPRO (Computers in Pilot schools)--one of the research projects of the ESP--that investigates a crucial factor in the endeavour to integrate computers: staff development.

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THE SITUATION AT THE START

The project COMPRO started in December 1987 with an analysis of experiences and current practice with computer use in the two pilot schools. The information was collected in four ways.

1. Information on **the experiences and current practice** with computer use was collected in December 1987 by a **questionnaire** distributed among the 169 teachers at the pilot schools, of whom 113 (67%) responded. At the time of the survey, about 38% of the respondents had made use of a computer, 32% had oriented themselves on computer use, and 30% had not. However, only 11% of the respondents had used a computer in their lessons. Within the past few years 19% had followed some external training on computers. Seventy eight percent indicated they had an interest in training. About half of the respondents were especially interested in subject matter-oriented training, but only 20% had the intention to use, within a short time, computers in their lessons. An interesting conclusion of this survey is that there appears to be a time lag of at least one year between an orientation to computers and their use in lessons, and that it will not be until approximately two years after the orientation that there is an obvious increase in computer use.
2. **Interviews** were held with the two computer coordinators and a random sample of 15 teachers about their current experiences and practice and their **preferences concerning computer use and inservice training**. A major conclusion from these interviews is that teachers are interested in information about the use of computers in the subject area they teach, computer use that fits into in the regular curriculum.
3. An assessment of **the attitude of all the teachers** of the pilot schools with regard to computer use was needed to know the initial strength and breadth of the support and interest in computers. This was measured in January 1988 by using a Dutch translation and adaptation (ref 1) of the **Stages of Concerns Questionnaire** (ref 2). The seven stages (subscales)in the Dutch version are: 1) Awareness, 2) Informational/personal, 3) Consequence, 4) Management, 5) Collaboration, 6) Refocusing, and 7) Revision. There were 52 questions. The response rate to this questionnaire was low: only 40% of the teachers filled it out. With reference to this response rate the computer coordinators reported that many teachers felt they had to analyze carefully the different questions, instead of simply responding in a spontaneuos manner. Also, many teachers found it to be a "boring" questionnaire because of so many questions that look alike, a characteristic of this type of questionnaire. An analysis of the average score on the subscales shows that the responses from both pilot schools follow the same pattern: the highest scores are on Subscale 2 (Informational/personal) and lower scores on the following Subscales. This pattern is characterised as a "non-user profile" (ref 2). The modal score on Subscale 2 is an indication that the teachers have a need for information concerning the integration of computers into the curriculum.
4. In the period February-June 1988 seven pilot **inservice workshops** were organized. Emphasis was laid on practical examples of computer use and on hands-on experiences. The workshops were highly appreciated. About 40% of the teachers attended at least one workshop and for 14 teachers it was their first experience with a computer. Although the examples were general, the teachers had special interest in the possibilities of the applications in the subject areas they teach.

FINDINGS FROM RESEARCH LITERATURE

Teacher-training studies have revealed important components of training. For maximum effectiveness of training, Joyce and Showers (ref 3) recommend five components to be combined, namely, theory, demonstration , practice, feedback, and coaching. The practice component is particularly essential in the case of training new activities like computer use. Findings from a number of computer training experiences demonstrate that "hands-on-practice" as the core instructional method is successful, and the training should be concrete and practical to motivate teachers (ref 4). Integration of computer use in the curriculum will be more likely to be enhanced when teachers in the same subject area work together. Furthermore, training becomes more effective when spread out over a period of time, allowing teachers to go back to the classroom and apply what they have learned (ref 5). Training that takes place at the teachers' school, delivered by enthusiastic and knowledgeable teachers who train their colleagues--a model known as multiplier training--provides ongoing support (ref 6).

A STAFF DEVELOPMENT APPROACH

Derived from the analysis of the ESP situation at its start and from the research findings, the two most important aims of the teacher training program for the ESP are:
- improving the skills and confidence of individual teachers in computer use,
- stimulating the interaction between teachers in exploring and realizing computer integration in their teaching practice.

With these two aims as guiding principles and taking into account other data from the analysis and the literature, the researchers of the COMPRO project and the computer coordinators of the pilot schools developed a plan for school-based teacher training. This plan consists of two components: a training in general computer skills and a training in computer use within a subject area. The computer-skills training is planned and executed by the computer coordinator. The goal of this training is to make teachers able to run ready-made software. It consists of five sessions, completed with individual exercises, and deals with basic computer skills and with word processing.

The emphasis in the overall teacher training program however is not on these basic skills but on the training of teachers within the same subject area, organized in one section. A section can start when at least some of its members master the basic computer skills, such as by following the computer skills training.

The training in the subject-area sections consists of the following five steps:
1. Orientation to and viewing of courseware on some subject belonging to the curriculum; selection of a courseware package;
2. Hands-on experience with this courseware package and exploration of the possibilities, the pros and cons;
3. Evaluation of these experiences and in the case of a positive conclusion, development of an instructional unit in which the integration of courseware in existing courses is realized;
4. Execution of the instructional unit in the classroom by different teachers and with observation by collegues;
5. Reflection on the execution and revision of the instructional unit.

Steps 1, 3, and 5 take place during meetings of the section, while Steps 2 and 4 are to be executed individually. One cycle of the five steps takes from three to five months. After passing four to six times through the cycle, a section can summarize its findings and proceed to a revision of the subject-matter curriculum with a view to computer integration. A section plans its own activities. The computer coordinator or the computer assistent are on demand, available for advice and support. One teacher from each section is responsible for the organization of the five steps and the continuation of the activities. These teachers meet together every six weeks with the computer coordinator to report their progress, to share experiences, and to discuss their problems.

This approach has now been practiced since November 1988. It is too early to obtain "hard" evaluation data. Although the sections started with characteristics of hesitation and uncertainty among the teachers, and to some extent this is still the case, the confidence by teachers and computer coordinators in the use of computers is growing. We expect that the results of the next assessment of the attitude of the teachers in September 1990 with the aid of the Stages of Concerns Questionnaire show the "experienced-user profile" (ref 2).

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No 2 - THE TRUTH:
TECHNOLOGY SHOULD REPLACE THE CURRENT ROLE OF THE TEACHER

Presenter: Don Stewart,*

1.0 A Brief History of Student-Oriented Technology

The history of education and educational technology are filled with the introduction of different types of technology which is accompanied by predictions that the technology will revolutionize education and help more students have success in learning. The postscript to the history of educational technology also contains a storage closet and a dumpster for the educational technology solutions which have become the victims of the traditonal educators' resistance to change.

1.1 Television

Educational television was considered by many to be the one technology that could really make major changes in student learning. Scores of research projects proved that television could present course content as well as the live teachers. The Ford Foundation and others spent several billion dollars on television equipment and research before giving up because the television forces were unable to overcome the resistance of the traditional educators to any change from the traditional live teacher lecturing to classes of students.

1.2 Programmed Instruction

Through the 1960's, hundreds of programmed instructional units were developed, validated and used. Hundreds of research projects proved that students learned more than the traditional educational approach and in a shorter time. The success stories were finally squashed and programmed instruction was sent to the closet and the dumpster by the traditional educators.

1.3 Language Labs and Dial Access Systems

Through the 1960's and into the early 1970's, thousands of schools and colleges installed language labs and hundreds installed dial access systems. Hundreds of thousands of students enjoyed the opportunity for individualized learning. Again, because these two technologies were replacing the traditional teachers' role of presenting course content, little by little most of these also ended up in the closets, in the dumpsters or unused in classrooms which are now used for other activities.

1.4 Computer Managed Instruction/Computer Assisted Instruction (Late 1980's Version)

With the advent of the low cost personal computers, thousands of schools have installed computers in one or more classrooms. Although there is now one computer for every 30 students, this only allows the average student about 30 minutes on the computer each week. For those of you who work with computers daily, you know that 30 minutes is hardly enough time to get started let alone really make a significant change in the traditional educational mal-practices. Already some of the traditional educators are complaining about the students who are having individual success on the computers and are missing out on the (***ineffective***) presentations of the "***live***" traditional teacher.

As more and more traditional teachers through their organizations are able to gain access and control over the budgetary decision making in the schools, they are going to be faced with the decision of spending more money on computers (***both hardware and software***) or to use that money to pay salary increases for the teachers. Given that decision to make, there should be little doubt as to what that decision will be!

The traditional educators may very well win again at the expense of successful student learning.

***Instructional Crisis Action Teams (ICAT) and SLATE Services, P. O. Box 80, Westminster, CA 92684 USA - Telephone 714/892-0889**

(For more information, visit the ICAT/SLATE booth in the exhibit area)

2.0 Technology Research - Presenting Teachers vs.Presenting Technology

There has been literally thousands of research studies of the type in which the traditional presenting teachers have been pitted against some form of technology. About two thirds of these studies have resulted in no significant differences between the two presentations.

3.0 Creating a Partnership - Professional Teacher's Role and Student-Oriented Technology

If the comparative research was set up to compare

- the teacher (*as a presenter*) vs. the technology (*as a presenter*) plus the teacher solving students' problems or
- the technology (*presenting*) vs. the technology (*as a presenter*) plus the teacher solving students' problems

the technology **PLUS** the teacher would win every time. In fact, there is no way that this winning combination would lose to either the teacher or the technology acting alone.

3.1 Traditional Mediocre Education vs. Instructional Excellence

During the past five years, a number of research studies by individuals, groups, universities and state and national commissions have released a number of reports and books on the status and conditions of traditional education along with their recommendations for necessary changes. The common thread among all of these publications is that our traditional educational system is in trouble. There shouldn't be any disagreement even from the traditional educators that something has to done. Our country can no longer continue to waste the minds of so many of our young people, the competitive future of our country and possibly the future of our international society.

With the technology you see in the exhibit room and with the appropriate teacher training for the **REAL** Professional teacher's role, it is possible to bring about Instructional Excellence wherein 90 percent or more of the students at all levels of education will be able to achieve 100 percent of their unit and course objectives. This goal can be achieved as soon as the current teachers at all levels of education are trained in their new role.

3.2 The Impact On Teacher Training

In February of 1988 at the national conference of the American Association of Colleges for Teacher Education, a news release stated that the most important question facing the participants was the identification of the skills and knowledge base which should be learned in order to be a competent teacher in the classroom. After training tens of millions of teachers over many decades in hundreds of teacher training institutions throughout the country, and the teacher training faculty are saying that they still have not identified the necessary knowledge base. You have to know that teacher training has got to be in trouble along with the traditional educational system.

3.2.1 Consider Traditional Teacher Training - Is It "*To Be Or Not To Be*"

Although there has not been very much research comparing teachers who have had teacher training vs. teachers who have **NOT** had teacher training, the few studies that I have read ended up with no significant differences. In any other profession, professional training makes a difference, i.e., a professional trained doctor certainly does different things with his/her patients than an untrained person can do. However, in community colleges where about half of the faculty have had teacher training and the other half have not had any training, I challenge anyone to tell the difference between the two by observing the two groups of teachers performing in their classrooms. No wonder the non-education faculty in higher education have doubts about the need for a department or school of education on their campus. In fact, some colleges and universities have already reduced or eliminated their teacher training effort. The only training which may be necessary to make presentations in a classroom is a knowledge of the subject matter to be covered. That is why there is the current emphasis on degrees in subject areas other than education and why alternative programs are allowing people with non-education degrees to become teachers with a minimum exposure to traditional teacher training.

4.0 *"What is Holding Back the Changes?"* and *"What Are the Barriers to Change?"*

If Instructional Excellence is what we want in our schools and many of the skills and knowledge needed for Instructional Excellence has been known for more than 20 years, there has to be reasons why the necessary changes have **NOT** been made long before this. After all, millions of students' futures have been sacrificed in order to maintain the use of the traditional educational mal-practices found in almost all schools at all levels of education.

4.1 First - There Are the Educational Traditions

The need by many teachers to continue to perform the traditional role of the presenter of course content in the classroom in spite of the fact that they know it is ineffective, borders on the behavior of a person who is addicted to "***something***". Could that "***something***" be the "***ego high***" of having so much "***power***" over the lives and futures of so many students?

4.2 Second - The Traditional Teaching Training

Almost all teacher training institutions teach the traditional presenting role of the teacher. The education faculty also demonstrate this traditional presenting role in their own classrooms. In supervising the education students in their practice teaching, the education faculty and teacher supervisors also evaluated the students on their performance as "***presenters***". Rarely are education students, who are doing their practice teaching, evaluated on the basis of how much their students have learned. Even rarer would be the education students who are evaluated on their ability to diagnose, solve and prescribe for student learning problems.

4.3 Third - Traditional Teacher Evaluation

The evaluation of most teachers in elementary and secondary education is based on observations of the teachers' "***performance***" in their classrooms. Rarely is a part of the teachers' evaluation based on how much the teachers' students were learning. In higher education, the "***publish or perish***" dictum is the primary evaluation criterion. Not only is the level of student learning not a part of the faculty member's evaluation, if a teacher does happen to be successful in helping his/her students learn more and gives out more "A's" and "B's" than other faculty; deans, department heads or peer pressure may be brought to bear on the teacher to not be so easy in grading. Oddly enough, the teacher in higher education who gives more "D's" and "F's" than usual is looked on as an acceptable "tough" teacher in spite of the evidence of ineffective teaching.

4.4 And Fourth - The Gate-Keepers

Another way of maintaining the status quo of traditional education is to have traditional educators in key positions to stop any major changes which might threaten the continuation of traditonal educational mal-practices.

4.4.1 There Are the Traditional Educators Who Are Advisors to the President, Governors, Legislative Groups, Commissions, etc.

Most of these consultants and advisors to the groups who are looking into the problems with traditional education are traditional educators. Major changes to traditional education don't get through the gate-keepers to the people who may have the influence to bring about the needed changes. For example, I've sent letters and my books to the President and other leaders in Washington and they'll probably never see them.

4.4.2.And the Readers and Evaluators of Proposals, Books, Articles, etc.

The same is true of these gate-keepers. As long as the readers of proposals submitted to foundations and research groups are traditional educators, proposals to make major changes to the traditional practices will not be approved or even seen by the funding groups.

4.4.3 The Judicial System

Even the Judicial system is on the side of traditional education. Not that the judges agree with the traditional educational mal-practices which result in normal students graduating from high school with only a second and third grade achievement, the problem is that these mal-practices are so wide spread among teachers that if one educational mal-practice suit made it through the courts, the courts could be flooded with millions of mal-practice suits. One of these days some judge will decide that the saving of millions of students is worth it!

5.0 What Are the Pathways to Change?

If **Instructional Excellence** is what is wanted and the traditional educators, as gate-keepers, are doing their share to keep out any major changes, then what can be done?

5.1 The Current Evolutionary Change May Take 20 Years or More - Maybe Never

Many traditional educators have complained about people who indulge in "*teacher bashing*" and claim that they need more time to bring about the needed changes. I heard these same complaints 25 years ago and since then 25 million students have become "*pushouts*". The key thought to remember is that traditional educators will **NOT** be the ones to make the necessary changes of their own free will!

5.2 However, There Is A Chance For A Non-Violent Revolutionary Change

The only way to diminish the current violence and to avoid more violence is to bring about the needed changes soon. We cannot wait any longer!

5.2.1 Who Has the Most To Gain Or To Lose?

When a school is effective, teachers and administrators have little to gain, When schools are ineffective, the teachers and administrators have little to lose. Only students and their parents have the most to gain or to lose when schools are effective or ineffective. As a result, parents and students will also have to be the ones to insist on the necessary changes. At the present time, individual students and their parents are at the mercy of the traditional educators and their traditional educational mal-practices. They do not have recourse. Educational mal-practice suits of individual students and their parents have not been successful.

Vehicles For Change - The Instructional Grievance Committees (IGC) - However, where the student and his/her parents were not able to get changes made as individuals, large numbers of students and parents will be able to bring about the needed changes and the elimination of the traditional educational ***mal*-practices**. The vehicles for this change will be the use of **Instructional Grievance Committees and Instructional Grievance Procedures**. Just like the teacher organizations who insist on the use of grievance procedures to protect them from unjust administrators, students and parents will use similar procedures to protect the students from unjust teachers. These IGC Committees will be made up of parents, students, taxpayers, local business people, teachers and school administrators but the non-educators will always be the majority.

Backed Up By the IGC Support Team (IGCST) - The IGC Support Team will consist of most of the students and parents in any given school, school district, college or university. Sort of a union of students and their parents. Hopefully most teachers and administrators will go along with IGC decisions aimed at increasing student learning. Because if they don't, the students and parents can use the same weapon of the teachers' unions - **the strike or boycott**. The overall goals are to increase student learning and help teachers to become real **Professionals.**

Classroom IGC Stewards As Monitors - One of the reasons for the continued educational mal-practices being performed in the classrooms is because once the classroom door is closed, too many teachers feel that they are free to do anything they want regardless of the negative affects on their students. In order to monitor the teachers' teaching practices, a student in each classroom will be elected to be the on-site **Classroom IGC Steward**. The **IGC Steward** and his/her parents will help any student or parent who wants to file a grievance to fill out the appropriate forms and guide them through the established grievance procedures.

5.2.2 .The Professional Non-Traditional Educators

As teachers are trained in **Instructional Excellence** concepts and drop their traditional educational mal-practices, they will become more successful in helping more students learn more. Once the teachers have made the changes, it would be hard to believe that they would really want to go back to being ineffective and to interfere with the learning of their students!

Instructional Excellence Support Team (IEST) - As some teachers at each school become experienced at being successful in diagnosing and solving student learning problems, they should form an **Instructional Excellence Support Team** to help other teachers who need help. Every school should have such a group available. Included with the successful teachers should be the librarian, a counselor, an audio/visual person and any instructional technology specialists available.

In closing, remember that successful student learning today will give us a successful country tomorrow with everyone sharing in that success!

Staff Development Approach to District-Wide Computer Literacy: Routes, Rationale, Results, and Replication

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ABSTRACT

Although significant progress has been made in the application of computers to K-12 instructional processes nationwide, equivalent incorporation of this technology across the managerial staff environment has lagged its instructional predecessor. With the exception of text and database/spreadsheet processing in the secretarial environment, the common application of computing to food service, transportation, first-echelon-level budgeting, internal scheduling of non-instructional activities, local inventory control, discipline accounting, curricular essential elements accrediting, and electronic mail (including bulletin boards) has little chance of becoming common-place within the next decade without the coordinated staff development of universal users.

INTRODUCTION

A structured staff development approach to district-wide computer literacy would incorporate elements of (a) curricular objectives, (b) expertise level, (c) cross training, and (d) scheduling, into a coherent policy formulation and instructional delivery package. The intended audience would involve the full range of the staff and faculty hierarchy. From the beginning foundations of hardware and software literacy, to the detailed application of computer technology within the individual staff member's locus of employment, this approach consolidates district-wide literacy and computing deployment in small-to-large school districts within a three-year period. Included within this approach are suggested methods for executing formal needs assessment, materials acquisition scheduling, and both formative and summative program evaluation activities throughout staff development activities.

APPLICATIONS TRAINING FOR USER PERSONNEL

Following the primary importance associated with (a) clearly identifying and understanding the comprehensive data manipulation needs of the school district, (b) objectively evaluating and selecting appropriate software based applications which will adequately and appropriately address these needs, and (c) efficiently installing and testing such hardware equipment as will effectively though economically operationalize these software based applications, remains the sine qua non necessity to promote a comprehensive and diversified training regimen for all potential users of the data processing system. Such a training program must involve the direct user, viz., individuals who will physically deploy the computing system, as well as the indirect user, viz., individuals who will come into contact with the system only through the results of its applications.

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The myriad problems connected with inadequate and/or inappropriate training can relegate even a superior hardware and software system to one of inferior status. Typically, the inadequately trained direct user never understands the full range of capability within the computing system. These individuals are likely to remain concerned only with particular applications identified during their initial training; and, furthermore, seldom seek or even recognize such modifications as might enhance the deployment of the system in their specific area of interest. When new direct users encounter the system, it is usually this earlier direct user who provides the initial training of the new user, coupling inappropriate training further with an inadequate background. For the part of the indirect user, little if anything is understood relevant to the capabilities of the system; and, therefore, this user remains content to accept inadequate and/or inappropriate applications as "all that the system is capable of" under present conditions.

Tactically, application training regimen for administrative versus instructional computing users is moderately distinct. For administrative computing users, the goals of training are associated with the deployment of data processing activities to support the instructional environment of the classroom. For instructional computing users, the goals of training are concerned with the actual instruction within the classroom setting. Based upon these differences, the training paradigm for administrative and instructional users must be somewhat different; and, moreover, lies in the context of the application(s) which will guide the user of the computing system within the daily functioning of the district.

At the same time, however, administrative users in one particular area must have a clear understanding of other administrative applications, though these users may not routinely come into contact with these 'remote' uses. Similarly, administrative users should have some rudimentary understanding of the deployment of instructional computing processes. Such "cross-applications" training objectives can be even more critical for the instructional computing user, since administrative computing processes maintain, as a primary mission, the support of instructional activities within the purview of the district.

SCHEDULING FOR MULTIPLE YEAR INSTALLATION

Installation of integrated administrative and instructional computing systems require a detailed schedule which matches indices of (a) planning, (b) preparation, and (c) evaluation across the several years of implementation. Table 2 displays a suggested schedule for the "top-twenty" desired applications incorporating elements from initial planning to final validation. This three-dimensional "Gannt" framework also provides a firm basis for both formative and summative control over the installation of all applications.

Concomitant hardware support installation can be scheduled graphically via a similar chart shown in Table 3. Such schedules not only display intended budgetary requirements over time but also demonstrate the long-range acquisition strategies of the school district.

Table 1. Perceived Software Acquisition and Training Needs of School District Based upon Perceptions of District Administrators.

Priority A-1 Software Needs	WORD AND SPECIAL EFFECTS PROCESSING
	PERSONNEL RECORDS AND PAYROLL
	STUDENT ATTENDANCE ACCOUNTING
Priority A-2 Software Needs	GENERAL DATA FILE MANAGEMENT
	INVENTORY MANAGEMENT
	T.E.A. ANNUAL PERFORMANCE REPORT
	STUDENT RECORDS AND ACADEMIC HISTORY
	STUDENT PROGRESS AND GRADE REPORTING
	DEPARTMENTALIZED STUDENT REGISTRATION
	STANDARDIZED TESTING ASSESSMENT
Priority A-3 Software Needs	REPORT FORMULATION
	STUDENT FOOD SERVICE ASSIGNMENT
Priority A-4 Software Needs	STUDENT BUS TRANSPORTATION ASSIGNMENTS
Priority B-1 Software Needs	ORDERING AND PURCHASING
	FINANCE AND ACCOUNTING
	COMPUTER ASSISTED INSTRUCTION, K-6
Priority B-2 Software Needs	REQUISITION AND DISTRIBUTION
	SURVEY DATA ANALYSIS
	CAREER LADDER ACCOUNTING
	ACCREDITATION MONITORING
Priority B-3 Software Needs	CALENDARING (BULLETIN BOARD)
	CAMPUS OR PROGRAM ENROLLMENT PROJECTIONS
	ESSENTIAL CURRICULUM ELEMENTS ACCOUNTING
	CURRICULUM PROGRAM DEVELOPMENT
	LIBRARY FUNCTIONS
Priority B-4 Software Needs	SHARED DOCUMENTATION TRANSFER
	INFORMATION QUERY
	OBJECTIVE TEST SCORING
	COMPUTER ASSISTED ENRICHMENT, GIFTED/HONORS
Priority C-1 Software Needs	COMPUTER ASSISTED INSTRUCTION, GRADES 7-12
Priority C-2 Software Needs	COMPUTER ASSISTED REMEDIATION, SPEC POPUL
Priority C-3 Software Needs	DECISION SIMULATION MODELING
	ELECTRONIC MAIL
	FACULTY INSERVICE ACCOUNTING
	INDIVIDUALIZED EDUCATION PLAN (IEP)
	INSTRUCTIONAL LESSON PLANS
	CAREER AND VOCATIONAL EXPLORATION
	8TH GRADE COMPUTER LITERACY REQUIREMENTS
Priority D-1 Software Needs	DISTRICT TAX COLLECT AND AD VALOREM ACCOUNT
Priority D-2 Software Needs	OCCUPATIONAL INFORMATION AND CAREER CHOICE
Priority E-1 Software Needs	COLLEGE SELECTION AND PLACEMENT

Table 2. Level of training in applications by station.

	EDC CTR		INSTR CAMPU			SUPPORT	
	Adm	Sec	Adm	Sec	Ins	Adm	Sec
STUDENT ATTENDANCE ACCOUNTING	S	S	S	S	S	A	A
PERSONNEL RECORDS AND PAYROLL	S	S	S	C	A	S	C
INVENTORY MANAGEMENT	S	S	S	S	A	S	S
STUDENT RECORDS / ACAD HISTORY	S	S	S	S	C	A	A
WORD / SPECIAL EFFECTS PROCESS	S	S	S	S	S	S	S
STUDENT PROGRESS / GRADE REPORT	S	S	S	S	S	A	A
GENERAL DATA FILE MANAGEMENT	S	S	S	S	S	S	S
T.E.A. ANNUAL PERFORM REPORT	S	S	S	S	C	C	C
REPORT FORMULATION	S	S	S	S	A	S	S
STANDARDIZED TESTING ASSESSMENT	S	C	S	C	C	A	A
DEPARTMENTAL STUDENT REGISTR	S	S	S	S	S	A	A
STUDENT FOOD SERVICE ASSIGNMENT	S	S	S	S	A	S	S
STUDENT BUS TRANSPORT ASSIGNMENT	S	S	S	S	A	S	S
ESSENTIAL CURRIC ELEMENTS ACCT	S	S	S	S	S	A	A
LIBRARY FUNCTIONS	S	C	S	C	S	A	A
FINANCE AND ACCOUNTING	S	S	A	C	A	A	C
ACCREDITATION MONITORING	S	S	S	S	C	C	C
COMP ASSIST ENRICH, GIFT / HNRS	S	A	S	A	S	A	A
COMP ASSIST INSTR, GRADES K-6	S	A	S	A	S	A	A
REQUISITION AND DISTRIBUTION	S	S	S	S	A	S	S

S =: skill level (primary user)

C =: cross training (backup user)

A =: awareness level (non-user)

Table 3. Multiple-year scheduling for applications installation.

	1986					1987
	Sp	Su	Fa	Sp	Su	Fa
STUDENT ATTENDANCE ACCOUNTING		P	DT	I	I	V
PERSONNEL RECORDS AND PAYROLL		P	DT	I	I	V
INVENTORY MANAGEMENT		P	DT	I	I	V
STUDENT RECORDS / ACADEMIC HISTORY		P	DT	I	I	V
WORD / SPECIAL EFFECTS PROCESS		P	DT	I	I	V
STUDENT PROGRESS / GRADE REPORTING		P	DT	I	I	V
GENERAL DATA FILE MANAGEMENT		P	DT	I	I	V
T.E.A. ANNUAL PERFORMANCE REPORT		P	DT	I	I	V
REPORT FORMULATION		P	P	DT	I	I
STANDARDIZED TESTING ASSESSMENT		P	DT	I	I	V
DEPARTMENTALIZED STUDENT REGISTR		P	DT	I	I	V
STUDENT FOOD SERVICE ASSIGNMENT		P	P	DT	I	I
STUDENT BUS TRANSPORT ASSIGNMENTS		P	P	DT	I	I
ESSENTIAL CURRIC ELEMENTS ACCOUNTING				P	DT	I
LIBRARY FUNCTIONS				P	DT	I
FINANCE AND ACCOUNTING		P	P	DT	I	I
ACCREDITATION MONITORING		P	P	DT	I	I
COMPUTER ASSIST ENRICH, GIFT / HNRS				P	DT	I
COMPUTER ASSIST INSTR, GRADES K-6	P	P	DT	DT	DT	I
REQUISITION AND DISTRIBUTION	P	P	DT	I	I	

P =: planning and scheduling

D =: deployment and training

T =: testing and piloting

I =: induction and evaluation

V =: validation and incorporation

THE DEVELOPMENT AND IMPLEMENTATION OF TEACHER PRODUCTIVITY WORKSHOPS BASED ON MICROSOFT *WORKS*

N. Bell*

ABSTRACT

State-level decisions are prompting institutions which focus on teacher preparation to offer coursework to prepare teachers in the use of computers in the classroom. In many cases the directives produced by the state departments of education are quite specific concerning the topics to be included in this coursework, and at the present time those institutions preparing teachers are in the process of modifying existing courses to provide those required experiences. This paper reports on the procedures followed in developing a course in the College of Education at Michigan State University to provide both pre-service and in-service teachers with what is believed to be that set of experiences that will fulfill the computer-related requirements in a majority of the states. The rationale for the selection of the topics for the course will be provided, as well as a description of the materials developed for the course.

INTRODUCTION

Recent surveys have indicated that the number of computers in the public schools in the U.S. results in a ratio of one computer for every thirty students. As thirty students has been long considered the maximum class size, it would appear that the average is one computer per classroom. However, in actual practice, because of the grouping of computers in laboratories, there is not yet one computer to be found in every classroom. But with the trend as it is, it will not be long before it would be expected that at least one computer would be found available for use in each classroom.

At the same time, the supply of teachers trained to use applications in the classroom has not kept up with the numbers of computers becoming available. As a result, it is estimated that only half of the teachers in the public schools have ever used a computer in their classrooms with their students for instructional purposes. And of the half that has used a computer for such a purpose, the majority most likely do not do so on a regular basis. So it appears that even though many more computers are now available in the classrooms, there will not be a marked increase in the use of the computers for instructional purposes by a majority of teachers until these teachers receive the training needed to make such use.

Because of such a situation, state departments of education are beginning to specify that teachers who wish to receive certification will have to demonstrate that they have had coursework related to the application of computers in the classroom. This is done on the assumption that without receiving such instruction, the teachers will be most likely to avoid the use of computers as tools to enhance instruction. Some of the states leading in the applications of computers in the teaching/learning setting have already passed legislation to that end and have set up committees of teachers, administrators, professors, and union and business representatives to determine the types of experiences which should be made available in such coursework. Generally it appears that the focus of such regulations in on the use of the computer as a tool, first to increase teacher productivity, and then for teachers to be able to provide instruction such that students will increase their productivity, again by using the computer at a tool. To that end, the introductory teacher education course at Michigan State University was revised to provide both pre-service and in-service teachers with these suggested experiences.

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CONTENT SELECTED FOR THE INTRODUCTORY COURSE

Through a survey of the lists of state requirements, especially those developed in California in response to Assembly Bill No. 1681, an initial listing of the required computer-related experiences was developed. Basically the decisions made by the special panel in California focused on the computer as a productivity tool, both for teachers and students, and also as a learning device for the students. Since the California approach appeared to be consistent with the listings available from other states, it became the general basis for the curriculum for the revised Michigan State course.

Consequently, the set of topics which were developed for the course were consistent with those in the California specification and included the following:

- Introduction to the Microcomputer
- Methods of Developing Keyboarding Skills
- Introductions to Word Processing, Electronic Spreadsheets, and Data Management and their Instructional Applications
- Introduction to the Programming Process and Structured Programming
- Computer-Assisted Instruction
- Instructional Applications of Telecommunications
- Instructional Applications of Desktop Publishing
- The Use of Teacher Utility Programs
- The Future of Computers in the Instructional Setting

Within the "Introduction to the Microcomputer" topic, the content is limited to the minimum information required to power-up a computer and run an application program. No details are included concerning how computers operate, since such information is not generally needed by the user. However, there is included in this segment of the course a rather detailed discussion on the societal impact of computing, with special emphasis on the difficulties arising from the inappropriate use of hardware and software.

In considering "Methods of Developing Keyboard Skills" only a brief introduction is provided to the importance of such skills, and then the participants are provided with a keyboard drill program and encouraged to check themselves out rather regularly with respect to speed and accuracy.

For each of the three major applications programs, word processing, spreadsheets, and data managers, the emphasis is upon classroom applications of such programs. Thus, with word processing, the course participants are shown how to produce classroom-oriented products such as worksheets, quizzes, tests, letters to parents, and various reports. With the electronic spreadsheet, the participants are shown how to create and update a gradebook, and also how to establish a budget for a project. The topics related to the data management program include student records, equipment records, a system for storing and retrieving curriculum information, and a reference system for professional reading.

A very brief time is devoted to the next topic, "Introduction to the Programming PRocess and Structured Programming." In no way is there a desire to produce programmers, but it appears that the concepts included in a discussion of structured programming can be important in the use of some of the data management programs. In using some of the more powerful data managers, it appears that the user is really required to program, only with the data management program the language is not Pascal, C, or Structured BASIC, but with a specially-designed language designed for use with the data management program.

With respect to the topic entitled "Computer-Assisted Instruction" an effort is made to demonstrate the various uses which can be made of computing as the *medium* of instruction. Thus the participants are introduced to four major uses: tutorial (including drill and review), inquiry, simulation, and problem solving. Each of these modes is demonstrated, and the participants are given the opportunity to experience the use of such systems with programs typical of what are currently available in the schools.

In the topic, "Instructional Applications of Telecommunications," the participants are introduced to the use of typical telecommunications systems. In addition to being taught how to use telecommunications software, the participants are provided with a simulation of an information system, in this case the McGraw-Hill Information Exchange, and then further provided with the opportunity to communicate using MIX.Descriptions are also provided of current projects in which telecommunications is involved in the instructional setting.

With the exponential increase in interest in desktop publishing, a brief unit was developed on the use of a typical desktop program, in this case Software Publishing's *First Publisher*. In this unit the participants are taught how to develop a multi-column document with text wrapped around imported clip art. Various typefaces and font sizes are also used, resulting in a very attractive document representative of the many such documents which would be most useful in the educational setting.

The unit on "The Use of Teacher Utility Programs" has as its focus those commercially-available software packages designed to increase teacher productivity. Included in this set are programs such as electronic gradebooks, lesson planners, attendance systems, and intra-school communications systems.

Finally, the course concludes with a look to the future. In this section demonstrations are provided of the use of interactive video, CD-ROMs, synthesizers, and other hardware and software not commonly found in the schools. This section of the course was also supplemented by the use of video tapes depicting future applications.

INSTRUCTIONAL STRATEGIES

With the topics identified in detail, it was then possible to turn to the task of developing the actual instructional materials. Because this introductory course is taught by a variety of instructors, ranging from advanced graduate students to senior faculty, it was felt that for continuity a series of materials should be developed as the backbone of the course. Then each of the instructors would be free to go beyond these materials, but at least make use of the materials to in some ways standardize the major topics of the course.

The initial approach with respect to instructional strategies was to develop a set of modules for each of the topic areas. Included in each set were statements relating to an overview for the module and a set of instructional objectives, a set of handouts similar to class notes, an instructional quiz using immediate feedback, and a set of hands-on activities providing practice in the use of the programs being taught. The overview and objectives were formulated to answer the participant question, "What is this lesson all about?" The class notes were used to assist the participants in maintaining focus on the important points being presented and thus answer the question, "What are the important point of this lesson?" The instructional quizzes were used to help the participants answer the question, "How am I doing in this lesson?" The activities were used to allow the participants to be able to answer the question, "Can I really apply all this information I am learning?"

With these modules developed, a system of formative evaluation was put in place to be able to assess their effectiveness. As data were collected and reviewed, changes were made to the modules to increase their effectiveness. Further, in this process of evaluation, there was a major effort at introducing into as many modules as possible alternative ways of mastering the same materials. For example, in the modules on the three applications programs, word processing, spreadsheets, and data managers, the computer-based training modules supplied with Microsoft *Works* were introduced and the participants given the choice of mastering the required skills either by attending instructor-led presentations, or by using the CBT materials. Presently there is a study underway comparing the effects of the CBT materials and the instructor-oriented presentations. Other such alternatives are continually being sought, with the final goal of reducing as much as possible the amount of time spent by the instructor presenting information concerning hardware and software operation.

SUMMARY

With the continuing increase in the availability of computing equipment in the classrooms there has to be the concomitant increase in the availability of teachers trained in the use of such hardware and software. Because it has been determined through surveys recently completed that many of the computers already available to teachers are not regularly being used, it is important for those institutions involved with preparation of pre-service and in-service teachers to respond to such needs. At Michigan State University a course has been designed and implemented which does much to prepare the teachers to make effective use of these powerful computer-related tools. The resulting course is a dynamic course in that changes are continually being made to make it more effective and cause it to make better use of the emerging technologies.

INFORMATION TECHNOLOGY IN THE LEARNING PROCESS

Jane E. Matthews*

ABSTRACT

Information Technology in the Learning Process (ITLP) is a local initiative in a Family of Schools in the North York Board of Education (Ontario, Canada). It is distinguished by three specific characteristics: the not-so-unique focus on computers in the writing process; the underlying use of the Concerns-Based Adoption Model (C-BAM) in its evolution; and, more unusual, the required involvement of all grade five, grade six, and grade nine English teachers. This paper will present a brief description of ITLP and concentrate on the observations and recommendations of the first-year report.

BACKGROUND INFORMATION

Based on a proposal written by an insightful secondary school teacher and carried forward by a visionary Assistant Superintendent, pilot project funding was obtained to place two Macintosh Plus computers networked to a printer in every grade five and six classroom in seven elementary and middle schools in the Family. In the English departments of each of the two secondary schools a lab of eight Macintosh Plus computers was placed for use by grade nine English students. The focus was on information technology and the writing process. MacWrite and MacPaint software and a data disk for every student were provided. In addition, the eighteen teachers involved were assisted half-time by a Computer Resource Teacher. Part of the Year-End Report, 1988, is reproduced below.

THE ROLE OF "SYSTEM PARTNERS"

In order to ensure that this innovation integrates and complements existing and on-going North York Board plans and initiatives and that professional development be effective, we ask the assistance of the following: Coordinator of English, Coordinator of Business Education, Coordinator of Intermediate, Senior Education, Coordinator of Primary and Junior Education, Coordinator of Computers in Education, Computers in Education team, and the resource person for C-BAM model.

It is essential that the teachers involved have on-going support beyond professional development workshops as well as technical assistance with troubleshooting. The committee recommends that this role be performed by: the convener in K-5 schools, one of the four conveners in middle schools, the Head of English and the Head of Computers across the Curriculum in secondary schools, and a Program Leader with the specific task of implementing computers across the curriculum at the Family level.

INDICATORS OF THE EFFECTIVENESS OF SYSTEM PARTNERS' SUPPORT:

- reduced need for support as teachers expand personal use skills
- increased need for support as teachers attempt lab management
- reduced need for support as teachers define own objectives for students
- increased need for support as teachers seek higher levels of use

OBSERVATIONS:

1. At the outset of the project, teachers needed support contact at least once per week. This need decreased over the year.
2. Elementary teachers spent less time building personal competence before taking the computer into their classroom than secondary teachers spent before taking their students into the lab.

RECOMMENDATIONS:

1. Communicate with system-level partners to engage their support for these specific aspects:
    - Coordinator of English -- application to the writing process
    - Coordinator of Business Education -- resources for keyboarding
    - Coordinator of Intermediate, Senior Education -- integration among subjects
    - Coordinator of Primary, Junior Education -- extension of Active Learning
    - Coordinator of Computers in Education -- participation in resource development

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- Resource person for C-BAM model -- ongoing support for implementation

2. The ongoing support of a facilitator is essential to the project; however, the ultimate success depends upon the classroom teacher's achieving independence.
3. Student independence and autonomy in applying technology to their learning is a long-term goal of this project.

AIMS FOR ADMINISTRATORS

Principals and vice-principals will have opportunities to: manage curricular implementation based on the C-BAM model; support and assist staff in the process of integrating information technology within the curriculum; consider the implementation of technology in the school when revising the 5-year plan; acquire a confident working knowledge of the Macintosh; use the computer as a management tool; and develop an understanding and appreciation of the use of the computer as a tool in the writing process.

INDICATORS OF GROWTH FOR ADMINISTRATORS:
The administrator:

- supports those staff members wanting to borrow a computer to learn at home
- acknowledges the time required for an educator to learn to use computer software before appreciating how it may be integrated within the curriculum
- ensures that 5-year plan objectives related to the implementation of technology in the school set realistic time-lines for staff learning
- chooses to use or to have someone else use computer software knowing from experience that it is appropriate to an administrative task
- chooses to use or to have someone else use computer software knowing from experience the advantages of that method over alternatives

OBSERVATIONS:

1. Computers placed in the office temporarily to facilitate administrators' learning about computers are being used almost exclusively by school secretaries.
2. Those administrators who were computer-users in the fall of 1987 are still computer-users. Those who were non-users remain non-users.
3. Those administrators who are computer-users tend to be more overtly supportive of staff borrowing computers than those who are non-users.

RECOMMENDATIONS:

1. Share with all principals tangible evidence of the professional growth of their staffs involved in the project: their concerns, their creativity, their commitment.
2. Provide all administrators with a practical demonstration of the value of the computer as a tool for the principal or vice-principal. Group or individual workshops with peer coaching may be appropriate.

AIMS FOR TEACHERS' PERSONAL USE

Teachers will have opportunities to: acquire a confident working knowledge of the Macintosh; create documents for specific purposes; use revision tools and publish materials for distribution.

INDICATORS OF GROWTH FOR TEACHERS:
The teacher:

- uses computer at school without students present
- uses computer at school with students present
- takes computer home for own use
- purchases own computer * (see RECOMMENDATION 1 below)
- participates in project group sharing meetings
- seeks information informally: chatting, visiting, reading
- seeks information formally: taking courses * (see RECOMMENDATION 1 below)
- shares own learning informally with other teachers
- shares own learning formally by giving courses * (see RECOMMENDATION 1 below)

OBSERVATIONS:

1. All of the above indicators were displayed by one or more teachers. Some teachers, however, displayed none of these indicators of personal competence.
2. Teachers who lacked keyboarding skill expressed the wish to acquire that skill once they began using computers for personal use.
3. Teachers appreciated practical assistance for using the computer to streamline administrative tasks.

RECOMMENDATIONS:
1. Teachers need to be told "up front" that the above indicators (excluding those followed by an asterisk *) are specific behavioral expectations for those involved in this project.
2. Teachers need keyboarding skills to model effective use of computers in the writing process.
3. Teachers need a library of "templates" (skeletons of documents) to help them apply computers to professional tasks. One example of this is a report card template.

AIMS FOR STUDENTS

Students will have opportunities to: acquire a confident working knowledge of the Macintosh; acquire keyboarding skills; learn to use the full range of tools in the software available; use the computer for publishing; use the computer for revising; use the computer for composing; use the computer for prewriting activities; and select software appropriate to the task.

INDICATORS OF GROWTH FOR STUDENTS:
The student:
- uses the Macintosh; assists others (students and staff) in using the Macintosh
- uses two hands; uses correct fingering; enters text without looking at keyboard
- applies the basic range of software tools; applies the full range of software tools
- uses the computer for simple publishing; improves writing; enhances product
- considers features of software when choosing the tool to solve a problem

OBSERVATIONS:
1. The number of computers, the number of students sharing access, and the minutes in the daily schedule when computers are accessible are all factors determining the average time that students have to increase their confident working knowledge of the Macintosh. Those who have had more opportunity to gain experience have become more confident and insightful users.
2. Students recognize the advantage of having keyboarding skills. For those at the grade 5, 6, and 9 level four to six hours of training using keyboarding drill software leads to a measurable improvement in facility.
3. Students grow to know the similar and dissimilar features of Macintosh programs.

RECOMMENDATIONS:
1. Strive to increase access time for all students by creative management of both equipment and time.
2. Include keyboarding skills in 5-year plans at the elementary, middle, and secondary schools.
3. During the second year of this project, all students should, in addition to the painting and word processing software already available, use: spell checkers, grammar checkers, style checkers, page layout software, databases, spreadsheets, animation software and Hypermedia.

ACTIVE LEARNING AND TRANSFERENCE

"Children learn by doing, but not just by doing. In order to understand what they know, children must be able to express it to themselves. To further clarify and refine their knowledge, they need to be able to share it in some way and be challenged by others. These steps -- experience, interaction, reflection, and communication -- are the components of active learning.

"In other words, children require first-hand experiences along with opportunities to think through and communicate those experiences. ... Active learners construct for themselves the tools with which they will eventually build the ability to reason abstractly. Creating and maintaining an environment in which active learning can occur is one of the key roles of the ... teacher."

--*North York Board of Education Document: Active Learning, page 10*

INDICATORS OF AN ACTIVE LEARNING SITUATION:
An Active Learning Situation: allows the learner to use existing knowledge in a new way; is structured so that the learner can actively observe and gather information; provides opportunities for both reflection and communication; can accommodate responses at various levels of complexity; requires the learner to make decisions, take risks, and view mistakes as opportunities for further learning and allows the learner to gather feedback and evaluate learning.

OBSERVATIONS:
1. The application of computer technology to the writing process at the secondary level brings to the English classroom all of the above characteristics of an active learning situation. What an exciting learning environment that offers secondary teachers and their students!

2 At this early stage of the project English students are arranging to apply the skills they have learned using the computer to other subject areas where written and graphic materials will enhance their assignments.

3 In elementary classrooms where students and teachers are functioning at higher levels of use of time, space, experiences and materials, and grouping, the addition of the computer learning centre was more readily accommodated than in those classrooms where students and teachers were functioning at lower levels of use.

RECOMMENDATIONS:

1. Support the potential of information technology to reduce the impact of teacher-centred strategies while creating student-centred learning environments.

2 Observe the ways in which active learning strategies support this project and this project supports active learning strategies.

CONCLUSION

These recommendations and others related to hardware and software, teachers' management strategies, teachers' curricular use, and the Concerns Based Adoption Model were presented at the end of the first year of the project. Based on those a number of major recommendations were stated. These were:

Continue:

1. ...the role of the implementation facilitator:
    - to develop and enhance personal use and management strategies
    - to coordinate and facilitate planning
    - to communicate and cooperate with system partners and school administrative teams

2. ...group planning sessions
    - to ensure that all involved share ownership in the planning and direction of the project

3. ...strategies that monitor and measure change
    - C-BAM monitoring instruments
    - track levels of use

Initiate the Group Planning Process:

1. ...plan at the school level:
    - use the review, develop, and implement cycle
    - work within the guidelines of the school/family/board 5-year plans
    - engage the active involvement and support of the school administration
    - cooperate with other staff to set objectives appropriate to the needs of the students
    - consider integration with Supervision for Growth (S4G)

2. ...plan with System Partners:
    - Coordinator of English -- application to the writing process
    - Coordinator of Business Education -- resources for keyboarding
    - Coordinator of Intermediate, Senior Education -- integration among subjects
    - Coordinator of Primary, Junior Education -- extension of Active Learning
    - Coordinator of Computers in Education -- reciprocal participation in resource development
    - Resource person for C-BAM model -- ongoing support for implementation

3. ...expand initiative to include other tool software:
    - spell checkers, grammar checkers, style checkers
    - page layout software
    - databases
    - spreadsheets
    - animation software
    - hypermedia

4. ...investigate networking and communications:
    - within classrooms
    - within the school
    - within the Family
    - across the Board (initiative of English Coordinator to link English offices in every secondary school)

EXPERT SYSTEMS FOR READING DIAGNOSIS

J. F. Vinsonhaler, L. A. Price [1]

ABSTRACT

The findings reported in this paper are part of a research effort begun almost ten years ago. The purpose of this effort is (1) to develop a model of reading diagnosis, (2) to build expert systems with the model that are capable of using commonly available data to generate good diagnoses of practical value in remediating reading problems, and (3) to improve the validity of the model and the expert systems through empirically comparing expert system decisions with human decisions. This paper summarizes past and current work.

INTRODUCTION

The motivation for the present work grew out of a series of observational studies of reading clinicians and others responsible for the diagnosis and remediation of reading problems (Ref 4). The process and products of clinicians were studied while they worked on cases of reading disability under controlled conditions. Each clinician diagnosed three cases: a first case, a second different case, and a third case which was identical to the first case except for superficial characteristics, i.e., name, parents' names, and so on. An important aspect of this work was the measurement of the reliability of diagnosis, i.e., the agreement between the diagnoses of the same case given by two different clinicians or by the same clinician on two different occasions. Diagnostic reliability was found to be startlingly low. Across the many studies, the average interclinician reliability (Phi coefficient) was .03, while the average intraclinician reliability was .21.

The diagnostic behavior of most clinicians was characterized by: (1) no generally agreed on strategy or procedure for collecting data on the reading case, (2) long rambling "diagnostic" reports which frequently lacked mention of major problems, e.g. poor visual acuity, and (3) an inability to relate their diagnostic decisions to an explicit theory of reading and reading diagnosis. A few of the clinicians in these studies showed much higher reliabilities (e.g., intraclinician reliabilities of .60 or more). The diagnostic behavior of the "reliable clinicians" was characterized by (1) a systematic strategy of data collection, (2) shorter diagnostic reports which emphasized major problems, and (3) the ability to relate their decisions to an explicit theoretical model of reading and learning to read, which generally emphasized six critical reading processes: sight word recognition, word decoding, vocabulary, oral reading fluency, reading comprehension, and listening comprehension.

These findings led the authors of the studies into two lines of research which were intended to provide the basis for improving diagnostic decisions. The first line concerned improving diagnostic reliability by training student clinicians to (1) systematically collect data, (2) diagnose more cases with corrective feedback, and (3) use the critical reading performances model as a basis for decision making. The training yielded average interclinician reliabilities of .65 (Ref 5).

The second line of research concerned the development of expert system "diagnosticians" to perform or aid with reading diagnosis. Simulated clinicians were developed using Digital Equipment PDP minicomputers and an inference engine written in BASIC and assembly language. These clinicians were then run on the cases of reading disability used in the observational studies. The results showed that expert systems could be constructed which duplicated the behavior of both the reliable and unreliable clinicians (Ref 2). However, the authors of these simulation studies judged the wide use of expert system diagnosticians as impractical at that time (1979) due to the lack of low cost software and hardware.

This paper reports a re-examination of the question of practical computer diagnosticians based on the Critical Reading Performances (CRP) model of reading diagnosis, using Expert System shells on personal computers. Our work is but part of a general resurgence of interest in computer diagnosis (e.g., see Ref 3).

THE CRP MODEL OF READING DIAGNOSIS

The Critical Reading Performances (CRP) model characterized the reliable clinicians in the observational studies of reading diagnosticians. The CRP model: (1) bases the initial diagnosis on the reader's performance on a set of key commonly agreed upon skills which are critical to the act of reading and (2) uses the reader's profile or pattern on these skills to guide further diagnostic decisions about fundamental causes and remediations.

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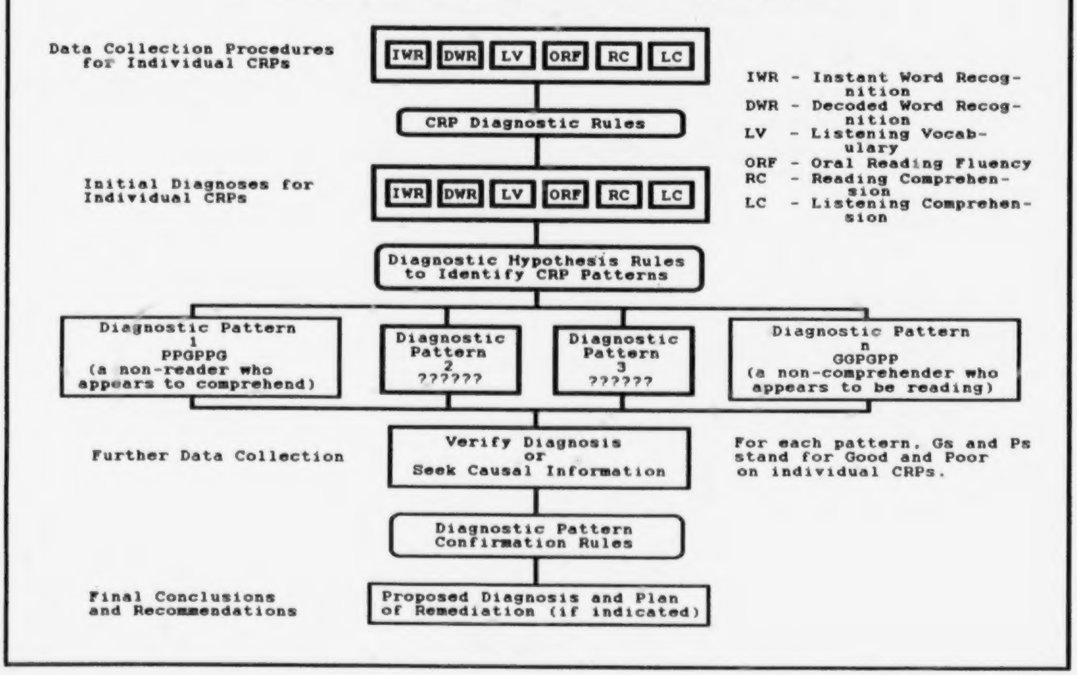
The Critical Reading Performances.
Each of the critical reading performances (CRPs) corresponds to one of the six processes which are assumed to underlie the reading process as it is defined in the public school. They are as follows: (1) Instant Word Recognition (the ability to instantly recognize commonly used words), (2) Decoded Word Recognition (the ability to use phonetic and other linguistic devices to analyze and blend word parts for decoding), (3) Listening Vocabulary (the ability to define words read aloud to the reader), (4) Fluent Oral Reading (the ability to read aloud without frequent pauses or errors at a acceptable rate), (5) Reading Comprehension (the ability to summarize or answer questions about a passage read silently), and (6) Listening Comprehension (the ability to summarize or answer questions about a passage read aloud to the reader).

The Diagnostic Process.
The model has two major premises. First, the model assumes that a reader in the public school should be judged as having a potential reading problem if he or she performs below an acceptable level (in terms of age, grade, or general ability) on one or more of the six CRPs. Second, the model assumes that problem readers can be sorted into diagnostic categories on the basis of their pattern or profile on the six CRPs, and that these categories are of value for further diagnosis of causes and for remediation. Figure 1 below illustrates the two-step nature of the CRP Diagnostic Model: the initial CRP Screening diagnosis which yields a profile over the six CRPs, and the subsequent final diagnosis of causes and remediation. Two common CRP patterns are also shown: the "Non-Reading Comprehender" (poor word recognition, and poor oral and silent reading, but with good potential as indicated by high vocabulary and listening comprehension) and the "Non-Comprehending Reader" (good word recognition and oral reading skills, but with poor vocabulary and comprehension). The latter is an example of the type of person who may be able to hide his functional illiteracy from teachers, perhaps throughout his school years.

Fig. 1 A Critical Reading Performances (CRPs) Model for Diagnosis of Reading Problems


Data Collection Procedures for Individual CRPs
IWR
DWR
LV
ORF
RC
LC
CRP Diagnostic Rules
Initial Diagnoses for Individual CRPs
IWR
DWR
LV
ORF
RC
LC
IWR - Instant Word Recognition
DWR - Decoded Word Recognition
LV - Listening Vocabulary
ORF - Oral Reading Fluency
RC - Reading Comprehension
LC - Listening Comprehension
Diagnostic Hypothesis Rules to Identify CRP Patterns
Diagnostic Pattern 1 PPGPPG (a non-reader who appears to comprehend)
Diagnostic Pattern 2 ??????
Diagnostic Pattern 3 ??????
Diagnostic Pattern n GGPGPP (a non-comprehender who appears to be reading)
Further Data Collection
Verify Diagnosis or Seek Causal Information
For each pattern, Gs and Ps stand for Good and Poor on individual CRPs.
Diagnostic Pattern Confirmation Rules
Final Conclusions and Recommendations
Proposed Diagnosis and Plan of Remediation (if indicated)

EXPERT SYSTEMS BASED ON THE CRP MODEL

The CRP Model has been used to develop several expert system knowledge bases using the VP EXPERT Shell (Ref 3) on the Tandy 1000 IBM PC compatible computer. We have studied the resulting diagnostic expert systems (DXES) by having them diagnose some of the cases of reading disability used in the observational studies. Figure 2 shows a typical interaction between one of the DXES for Stephen, a comprehending non-reader whose major causal problems are poor instruction on word analysis skills and a simple lack of practice in reading. Our measure of diagnostic validity was agreement with a diagnosis of the case formed by combining the diagnostic statements agreed upon in the observational studies by a majority of the unreliable clinicians and all of the reliable clinicians.

FIGURE 2. SAMPLE DIAGNOSTIC SESSION FOR AN EXPERT SYSTEM.

CRP EXPERT SYSTEM FOR READING DIAGNOSIS
Does the Dolch Word List indicate that the reader can instantly recognize common works at the appropriate level?
Yes [✓ No]
Does the Durrell Word Recog. and Word Analysis test indicate that the reader can recognize and blend word parts at the appropriate level?
Yes [✓ No]
Does the Gates MacGinitie Vocabulary subtest indicate that the reader can correctly identify the meanings of vocabulary words at his or her grade level when the words and foils are read aloud?
[✓ Yes] No
Does the Oral Reading portion of the Durrell Analysis of Reading Difficulty indicate that the reader makes frequent mistakes, repeats words, ignores punctuation, or reads slowly?
[✓ Yes] No
Does the Durrell Listening Comprehension subtest indicate that the reader is able to comprehend passages at his or her appropriate grade level?
[✓ Yes] No
Does the Durrell Silent Reading subtest indicate that the reader is able to read with adequate comprehension passages at an appropriate grade level?
Yes [✓ No]
This reader's problem is mainly poor sight words, poor word analysis and blending skills, and inadequate oral reading fluency. The reader's potential for comprehension is good. I recommend that the client be tested for visual and auditory acuity, and that an immediate remedial program be started for word recognition and analysis, both in isolation and in context. The reader should read orally to a good reader for at least 20 minutes per day.

RESULTS AND CONCLUSIONS

Are Practical Expert Systems Possible at the CRP Screening Level?

We have encountered no great difficulty in creating DXES's which provide valid diagnoses at the CRP screening or pattern level and which mirror the data collection strategies of the reliable reading clinicians. However, these DXES have two severe limitations: (1) the case must include performance data on a specific set of measurement devices or observations for each of the vital signs and (2) the person using the DXES must be able to correctly judge the adequacy of the performance, e.g., as satisfactory or not satisfactory.

Several possible methods might be used to meet these problems and make the wide use of DXES possible. For example, one might use the capability of expert system shells to store and retrieve data bases for each age or grade level. Each data base would include the names of common reading test and criterion values for these tests at the given grade level. Then general rules could be placed in the knowledge base which would directly judge the adequacy of the reader's performance. In this manner, the same DXES could be used with the particular reading performance measures applied in a given school or school district. Another approach might be to provide ancillary materials with the DXES to permit teachers or clinicians to create their own measures for the CRPs using reading materials from the classroom (e.g., see Ref 6).

Are Expert System Diagnosticians Possible at the Causal/Remedial Level?

Thus far, we have been unable to generate successful DXES at this level. As in the case of many intractable AI problems, we lack fundamental knowledge. There seems to be no general agreement among clinicians on what CRP patterns should be used for further diagnosis or remediation. Further, there seems to be little agreement on the fundamental causes of reading problems and on the most effective remediations. The field of reading seems to lack a fundamental tool of modern medicine: the Center for Disease Control, i.e., a major data source for epidemiological studies and clinical trials. Wagner (Ref 6) has documented this problem and suggested how a CDC for reading could be created using CRP diagnostic expert systems as data collectors.

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IMAGES AND ARTIFICIAL INTELLIGENCE IN COMPUTER AIDED EDUCATION: OUR PROTOTYPE BIRDS

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ABSTRACT

Artificial Intelligence (AI) has found its way into Computer Aided Education (CAE), and there are several systems constructed to put in evidence its interesting advantages. We believe that images (graphic or real) play an important role in learning. In this paper we explain the structure used for our knowledge base in ornithology and how we see the architecture of an Image based Intelligent Computer Aided Education system (IICAE).

INTRODUCTION

"Inspire interest, attention and curiosity into the children at school" is a vast subject that has preoccupied educationalists for decades. One of the good synthesis on this subject is particularly that of V. J. BASSAN in 1976 (ref 2). Among the recent propositions that go in this sense are two domains but which unfortunately are not always concommitant : the use of computer, and the use of image.

What is called CAE (Computer Aided Education) is at the begining a simple repetitive teaching but which by its complexity and rigidity does not satisfy neither the teacher nor the student. The introduction of Artificial Intelligence (AI) and the flexibility brought along is already a great step forward towards the conception of tools capable of retaining the student's attention which gave birth to ICAE (Intelligent Computer Aided Education) .

The use of images (for example images on videodisc) has proved its efficiency in developing curiosity in the student. Our work is at the confluence of AI, CAE and image search. We want to propose to the student a system that is flexible, capable of making deductions, helping and understanding him, basically using images. This is what we call IICAE (Intelligent Image based Computer Aided Education). This is a "new" research domain (ref 9, 11 in a special number of TSI dedicated to applications of computer science in training vol. 7 n°1-1988 and the acts of congress at Cap d'Agde in 1987, in particular (ref 3, 8, 10)). We have developed a prototype using the C language and an inference engine called OPS5 on a micro computer PC/AT and a videodisc reader VPD31. The chosen videodisc is the British Garden Birds edited by the BBC. In the following paragraphs we shall present the representation of our knowledge base in ornithology, the architecture of our prototype (particularly the aspects of the student model). We conclude with the developments of our work.

REPRESENTATION OF OUR KNOWLEDGE

As an experimentation, we chose the pedagogical objective as the capacity to associate the morphological characteristics of birds with the types of nutrition. We have some knowledge on the types of nutrition and characteristics of birds. We established the links between the types of nutrition and the characteristics based on the knowledge we have on the general morphological caracteristics of the concerned birds.

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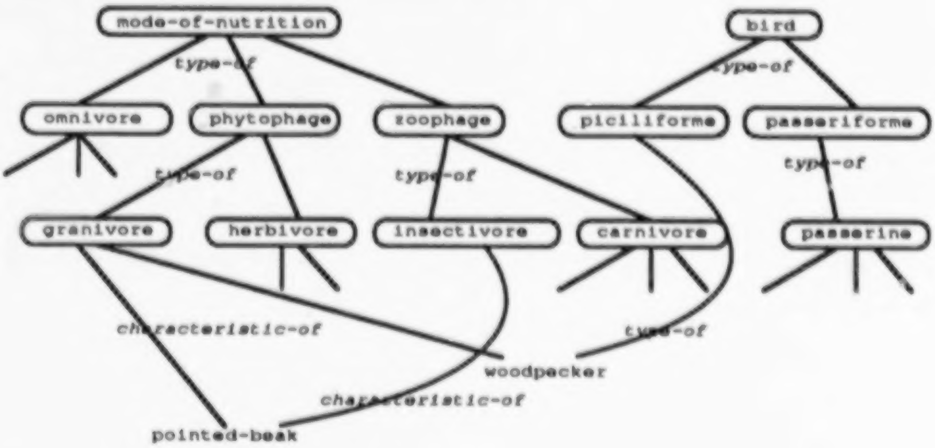
In the following figure, we give an example of our knowledge in form of semantic network (ref 5, 14). The network is a graph. The nodes represent concepts or objects, that we can consider as elementary knowledge. The arcs represent the relationships between the elementary knowledge. For example, in the network, pointed-beak is at the same time a characteristic of ***granivore*** and of ***insectivore***, woodpecker is at the same time a type of ***granivore*** and also of ***piciliforme***, and "passeriforme" is used for "passerine".

Note that we have chosen a semantic network representation because our principal interest is to know the relationships between the elementary knowledge. We constructed the network by classifying the types of nutrition and the birds according to their morphology.

Fig. 1: Semantic network of the knowledge base



We distinguish two types of elementary knowledge (concept or object), in our conception. There are visible objects such as trees, insects, grains, fruits, a long leg, and there are concepts that are not directly visible, or visible objects that are considered as concepts because of their use in a particular context, for example phytophage, beak (which is considered as a concept if it is not followed by a qualifier in the natural sciences' class).

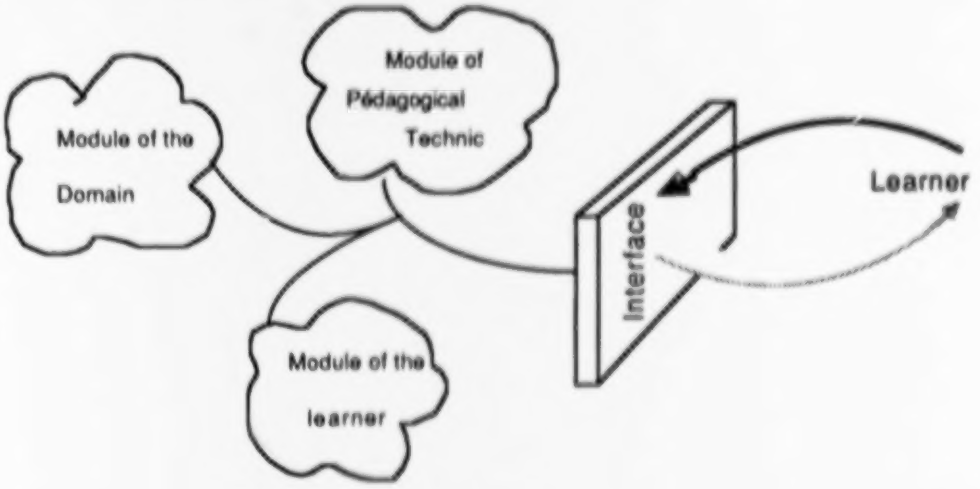
THE ARCHITECTURE OF AN IICAE

The following figure shows the architecture that we propose for an IICAE. It is composed of three modules. The **domain module** which should contain all knowledge related to the domain under study such as in the semantic network and the descriptive base for the used images. The **pedagogical technic module** which should define the heuristics, the objective and the technics of move within the system. In order to individualize and be capable of evaluating the performance of the learner as well as that of the system, the system should allow the creation of the **learner's module** (his profil). The need for the exploitation of the learner's module is not a recent awareness. In traditional education for instance where a tutor is in front of 20 to 30 students in the same class, the need is long been sensed for the necessity of individualization for a better academic performance. There are studies and synthesis done on the learner's module especially in (ref 6, 7, 13) which concerns what the module should be, and what can the module be used for. In our project, we want to use the learner's model mainly for pedagogical need for example (among other things) for understanding the learner's need, help in changing pedagogical objective if the need be, and for evaluation facilities. Most presentation on developments with the application of the learner's model in most publications were a posteriori to the system's development so we have decided to adopt an approach in the reverse order. The use of the system will then be facilitated by the use of an **intelligent interface**.

Among the several propositions for the structure, functions and representation of the learner's model, we have retained that of SELF (ref 12) presented in (ref 9). He considers the learner's model as a quadruplet (P, C, T, H) in which we consider:
- P as describing the learner's "factual" knowledge (which is for SELF the "procedural" knowledge);
- C as describing the learner's "conceptual" knowledge;
- T as describing the particularity of the learner;
- H as stocking the history of the learner's past interaction with the system.

The set $k = P \cup C$ describes what the learner knows, and K is the knowledge to be acquired. SELF also identified six categories of fonctions of the learner's model : corrective, elaborative, strategic, predictive and evaluative. Our learner's model is defined in collaboration with experts in pedagogy.

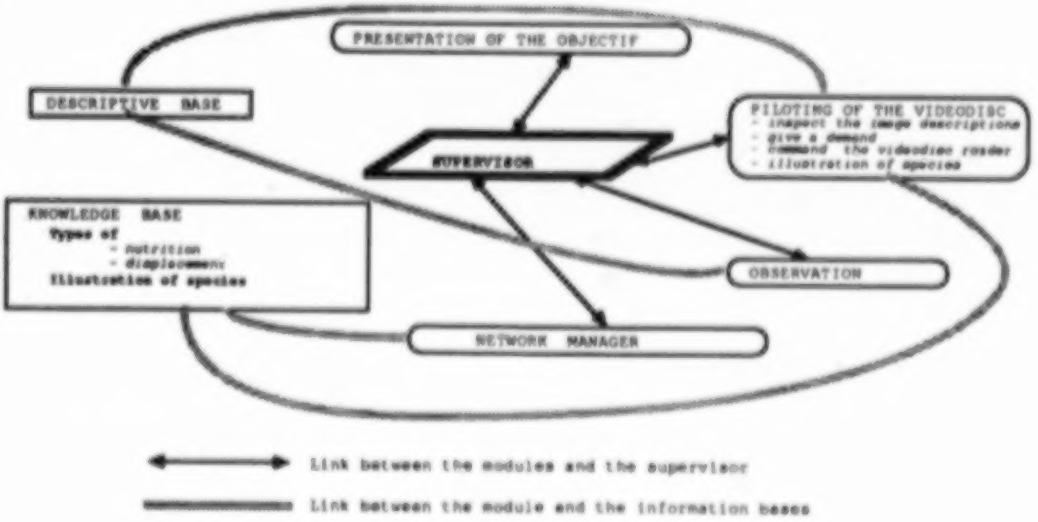
Fig.2 Architecture of an IICAE system



THE PROTOTYPE

In the prototype, we have created the semantic network(the knowledge base), the descriptive base(where we stocked the descriptions of images) and have implemented some heuristics for the reformulation of the learner's demand. The system is directed by a supervisor (SUPERVISOR) that takes the different decisions (according to the user's demand) during the process of execution. Other than the treatement of the learner's demands, the system offers the possibility of piloting the videodisc reader from the computer with all the possible commands (like searching for images, accelerating the play, play backward, slow, etc). The prototype also allows to see the species of birds of the disc as inside a film (to see how they move, how they feed, etc) in the task module called PILOTING OF VIDEODISC. In the task module called OBSERVATION, the system presents to the user the images corresponding to his demand after the application of heuristics. He can then select images that are of interest to him or reject some, or skip over some. The task module called NETWORK MANAGER takes care of the application of heuristics. The pedagogical advantages of the prototype even only with the application of heuristics and the use of real images is been appreciated by educationalists to whom we have presented the system. There are some other heuristics built into the system and other interface facilities which are not presented in this paper. We give in the following figure the schema of the prototype.

Fig.3 Global schema of the prototype


PRESENTATION OF THE OBJECTIF
DESCRIPTIVE BASE
SUPERVISOR
PILOTING OF THE VIDEODISC
- inspect the image descriptions
- give a demand
- command the videodisc reader
- illustration of species
KNOWLEDGE BASE
Types of
- nutrition
- displacement
Illustration of species
OBSERVATION
NETWORK MANAGER
Link between the modules and the supervisor
Link between the module and the information bases

CONCLUSION

In this "short" paper we have tried to explain how we have constructed our semantic network in ornithology and our propositions for building an IICAE system. We are presently completing our prototype with the implantation of the learner's model and we shall test the system in a natural sciences' class at a college in Nancy France.

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ON GETTING "INTELLIGENCE" INTO INTELLIGENT TUTORING SYSTEMS: CONSIDERATIONS AND TECHNIQUES FOR KNOWLEDGE ACQUISITION

K. L. McGraw*

ABSTRACT

The purpose of this paper is to examine the various subtasks within the process of acquiring knowledge for intelligent tutoring systems and to suggest techniques that may be used to complete these tasks. First, the complexity of knowledge acquisition for intelligent tutoring systems is discussed to provide readers with background information on knowledge acquisition for knowledge based systems and how it differs from knowledge acquisition for ITS. Subsequently, the qualifications and roles of the knowledge acquisition participants--the knowledge engineer and the subject matter expert--are presented. Finally, a set of techniques for the acquisition of knowledge for an intelligent tutoring system are outlined.

INTRODUCTION

Intelligent tutoring systems (ITS) are a genre of advanced computer programs that have emerged from the integration of artificial intelligence (AI) techniques and computer-based training. Originally designed as research tools to investigate the necessary components and feasibility of such systems, they offer promise as instructional tools both within traditional educational settings and for on-the-job training. However, like any computer-based training tool, their usefulness is determined by the extent and validity of their instructional components and content [8]. More than just being based on "information" within a subject area, they must be based on "knowledge." That is, they must reflect not only the facts within the subject, but also the way that experts *use* that information to make decisions, solve problems, and teach others. In fact, Johnson contends that the most important lesson learned from ITS development to date is that they must embody the knowledge of subject matter experts [5]. To do so, developers must be able to elicit and translate a subject matter expert's knowledge. This process is termed knowledge acquisition (KA) and has previously been referred to as a problematic task in the development of knowledge based systems [4]. Yet the developer's ability to acquire valid content, curricular, and pedagogical knowledge may be the determining factor in whether intelligent tutoring systems become efficient educational tools.

COMPLEXITIES OF KNOWLEDGE ACQUISITION

Knowledge acquisition for the purpose of creating an ITS differs from knowledge acquisition for knowledge based systems in its increased degree of complexity. Not only must developers decompose knowledge into rules, models, and simulations that work in the content area, but they also must use knowledge acquisition to create a meaningful curriculum of instruction [13, p. 15]. Thus, the purpose of knowledge acquisition is extended -- from simply eliciting and translating knowledge and expertise within a domain to include the following [7]:

- Capturing the knowledge that allows experts to compose instructional interactions [16]
- Discerning the approaches that seem to differentiate between experts and novices in a domain
- Identifying the mistakes that are most typical for novices and intermediates to make.

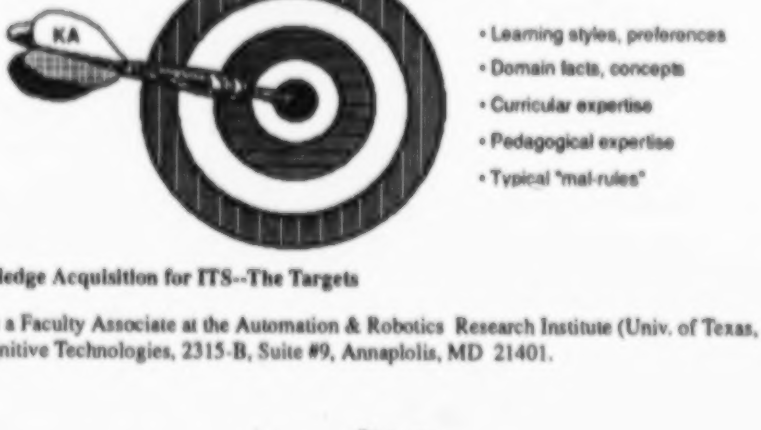

Figure 1. Knowledge Acquisition for ITS--The Targets

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Knowledge acquisition for ITS must also address the need to elicit and translate knowledge about typical learners in the domain (i.e., the student model) and pedagogy that determines how that knowledge should be communicated to students (e.g., mixed initiative dialogues, coaching, guided discovery) (Figure 1).

PARTICIPANT ROLES

Participants in the process of acquiring knowledge for an ITS may include a number of individuals, from subject matter experts (SMEs) to knowledge engineer (KEs).

The Subject Matter Expert

Decomposing knowledge in complex subject matter domains demands the assistance of experts in that domain for several reasons. First, most developers support the view that knowledge for ITSs should be acquired from real-world experts (i.e., subject matter experts) because they provide a fast, efficient route into the knowledge base [16]. Second, subject matter experts provide the developer with access to knowledge about a *curriculum* of instruction [11]. Third, a SME is typically the person best suited to restructure the domain so that "salient knowledge and heuristics for troubleshooting are emphasized" [13, p. 17]. Fourth, SMEs can help to restrict the exponential combinatorics of troubleshooting alternatives to manageable proportions.

Johnson [5] summarizes a number of "lessons learned" in working with SMEs during the development of an intelligent tutoring system (p. 32).

- Involve SMEs early in the construction of an ITS so they have vested interests in employing it and making it succeed.
- Acquiring knowledge for an ITS from a SME lends a face validity to the project that motivates learner and instructor
- Failure to involve a technical expert or risking alienation of the SME jeopardizes the quality of the knowledge base
- SMEs understand operation of technical equipment, expert rules for system operation and maintenance, and instructional needs of students
- SMEs can ensure positive attitudes within the organization for which the system is being developed.

In general, technical experts who serve as instructors are effective SMEs [5]. These individuals are people-oriented, combine technical and instructional expertise, understand instructional systems development, understand technical pedagogy, translate technical material for instruction, and are interested in instructional technology (p. 28-29). Other authors [7] note that experience in the role of "doer," followed by experience in the role of "trainer" may make it easier for the technical expert to express the deep structure of his or her knowledge (where "doing" skills and "training" skills are equally competent).

Specific responsibilities of a subject matter expert during the ITS development process include:

- Assisting as a mentor or guide during the "domain familiarization" phase, in which key documents and materials are identified and background information is supplied
- Serving as the source for the development of a knowledge dictionary, a set of domain terms and acronyms that are compiled for background and communication
- Reviewing functional goals for the system and for the various development cycles
- Reviewing knowledge acquisition plans and goals
- Preparing for and participating in knowledge acquisition sessions
- Reviewing notes from knowledge acquisition sessions for clarification and verification
- Continually reviewing and evaluating prototype efforts.

The Knowledge Engineer

The knowledge engineer plays a number of interrelated roles. As an analyst, he or she decomposes domain knowledge and investigates instructional issues to suggest system design. As a communication facilitator, the KE works with selected SMEs to isolate the different types of knowledge used in the domain, basic domain facts, and the heuristics that guide their use. As an instructional designer, the knowledge engineer is responsible for acquiring pedagogical heuristics that guide instruction in the domain and using this knowledge to structure interactions between the ITS and its learners. Specific responsibilities include:

- Become familiar enough with the concepts/vocabulary of the domain to converse with SMEs
- Select appropriate SMEs and orient them to ITSs in general and desired functionality and development methodology for the system being developed
- Enlist management support in securing continued access to selected SMEs
- Plan and conduct knowledge acquisition sessions based on a systematic methodology
- Derive ITS component design (e.g., student model) based on SME knowledge

- Implement design efforts to produce increasingly-more-complex prototypes of the system
- Spearhead user interaction with and SME evaluation of components in a systematic fashion, compile feedback/results, and refine system.

TECHNIQUES FOR KNOWLEDGE ACQUISITION FOR ITS

Instructional systems development has been applied successfully to the development of computer-based training and provides a model upon which ITS designers can base ITS development. Instructional design efforts typically involve the following tasks prior to code development:

- Analysis of system/software requirements
- Identification of objectives and concepts to be taught
- Delineation of the tasks involved in the process of learning a particular topic or how to use a specific device
- Selection of the sequence of instruction based on the previous conceptual and task analysis
- Selection of a presentation strategy (e.g., game, Socratic method, etc.).

Knowledge acquisition for the purpose of developing an ITS should address each of these procedures through the selection of different types of acquisition techniques and the sequence in which specific types of information is acquired. McGraw and Harbison-Briggs describe a systems-oriented knowledge acquisition methodology that enables developers to manage this process through the selection of techniques based on phase of development, domain, and goals [7].

CONCEPTUAL ANALYSIS

Conceptual analysis helps to define the overall structure of the ITS and makes apparent specific subdivisions within the domain. The purpose of conceptual analysis in the development of an ITS is two-fold. First, it helps developers recognize mental models that SMEs hold of the domain, which can be used to subdivide the domain and identify subdomain specialists. Second, conceptual analysis can yield key concepts, vocabulary used to refer to them, and critical interrelationships among concepts.

Specific techniques that are useful for initial ITS development include taxonomic development, conceptual dictionaries, mental maps, and conceptual frameworks [7]. When using any of these techniques to develop a mental model of the domain, developers are cautioned to carefully select SMEs. For example, Tenney & Kurland [14] noted that an analysis of drawings of novice and expert technicians indicated that novices focus on physical aspects of the domain, while experts focused on functional aspects and information flow (p. 62).

CONTENT ANALYSIS: PRINTED DOMAIN EXPERTISE

"Formal" documents in a domain, from technical manuals and courseware (printed or computer-based) to design documents and specifications, provide other sources of domain knowledge useful to ITS developers. Some developers suggest formal analysis of these materials. A more feasible approach is to use the documents' outline and structure as a "first-cut" at the framework for instructional content. Additionally, researchers have noted that letting SMEs use these materials during process tracing sessions and noting *what* was used *when* and *why* can help isolate critical material and typical information needs [14].

TASK ANALYSIS

Task analysis procedures examine tasks that are essential to performance on domain problems. A task analysis should yield (1) tasks constituting target performance for the job and (2) skills involved in performing the target tasks [9] [10]. The result of a task analysis for ITS development should be a decomposition of tasks into meaningful, context-based units that will facilitate learning. The resulting units should depict at least the following information:

- Task name, unit number, or other identifying information
- Associated subtasks
- Special cues, checkpoints, or critical values (e.g., gauge readings)
- Enabling activities or prerequisite skills.

Additionally, Means and Gott [12] suggest that a task analysis should contain information that helps developers identify specific difficulties domain novices encounter when performing the task or subtask. Farr [1] reports that it is also useful to rate each task component for its memorability and complexity to provide training beyond criterion and insulate skills from decay with disuse [3]. From this information developers can construct an expert model and a structure for the student model such that tasks are structured hierarchically as prerequisite skills, primitive skills, and groups of subskills relating to the completion of a given task.

PROCESS TRACING

Process tracing enables developers to "track" a SME's train of thought while solving a problem or completing a task [15] associated with the domain. These sessions can take many forms, within which a number of techniques can be applied. For example, in one type of session the SME talks about his or her decision process while completing the task. These are termed concurrent verbalization or "think-aloud" sessions. Because of problems reported with the validity of verbal reports on problem solving and because it may be difficult for the expert to describe these processes during task completion, knowledge engineers may choose to use retrospective verbalization. In retrospective verbalization the SME completes the task first and discusses the process later, using memory cues (e.g., session notes, videotape) from the session.

There are a number of methods that can be used to set up a process tracing session [7]. Environmental observation enables the developer to monitor the SME in his/her work session. Simulated scenarios present the SME with actual data from a problem that has been solved, requests a solution, and later compares and discusses both solution processes. Episodic analogies draw on the SME's tendency to use analogies when confronted with a new problem. Discussions between SMEs while solving a simulated problem are another means of securing valuable decision making information. Recently researchers used a 3-person technique in which one expert creates and inserts salient problems for the other expert or novice to troubleshoot under supervision while the KA expert monitors the situation [14]. Due to the amount of nonverbal knowledge that this type of session produces (in addition to typical verbal knowledge), knowledge engineers may find it useful to videotape them for later analysis.

CONCLUSIONS

For intelligent tutoring system technology to move from research settings into training environments, considerable attention must be paid to the process of acquiring the many different types of knowledge required. Like expert systems, ITSs must have a knowledge base of domain facts and heuristics for using these facts. However, ITSs also require knowledge of domain curriculum, pedagogy, misunderstandings, and knowledge about the use of student parameters (e.g., learning styles, etc.). Participants in the knowledge acquisition process include domain or subject matter experts and knowledge engineers. Using knowledge acquisition techniques including conceptual analysis, content analysis, task analysis, and process tracing knowledge engineers can design, and later develop intelligent tutoring systems that have content and instructional validity.

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AN INTELLIGENT SYSTEM FOR TUTORING BASED ON DEEP KNOWLEDGE

F. Gardin, G. Arienti

ABSTRACT

In this work we describe an intelligent tutoring system, UNIX_TUTOR, for the teaching of the UNIX* operating system.

The work was preceded by an analysis of Unix sessions which showed two classes of user, novices and experts, with different problems: for the novices, a lack of problem-solving strategies, and for the expert, an incapacity to justify the solutions given in the exercises or rather a lack of deep knowledge about the domain, as well as the presence of such typical misconceptions.

It was decided therefore to develop a diagnostic tutor looking at the expert users, implementing the following modules: ideal model, student model, diagnosis module, explanation generation module.

This analysis lead us to realize an **ideal model** based on deep knowledge which has been shown to be the missing element in the class of users UNIX_TUTOR addresses.

The system provides exercises for the student and, through the analysis of the given solution, is able to diagnose any misconceptions, to recognize alternative solutions and to infer a model of the student. The approach followed for diagnosis is reconstructive, so it is not necessary to list all the errors which the system can recognize so long as these errors are of a type known to the system.

The **student model**, a Buggy type, monitors the level of knowledge reached by the student not only in terms of partial knowledge but also of any misconceptions. It is also of a qualitative nature.

The **explanation generation model** permits explanations which are adapted to the model of the student using the knowledge expressed in the ideal model to respond to the requests of the student and therefore to amplify the concepts implied by the request.

The aim of the present work was firstly to evaluate the appropriateness of Sowa's conceptual graphs formalism by means of a concrete application for this class of problem.

The basic result has been the verification that this formalism is appropriate, both in capturing deep knowledge in the ideal model and the various misconceptions in the student model. It has also been possible to put together a type of deep reasoning, in a way relative to the problem of recognizing alternative levels.

After the description of the experimental analysis and a brief introduction to the concepts of deep and superficial knowledge, the architecture of the system and the modules with which it is made up.

The system has been developed in Prolog 2 on IBM AT personal computer.

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HYBRID TECHNOLOGIES FOR EARLY CHILDHOOD EDUCATION: APPLICATIONS IN DEVELOPING NATIONS

J. P. Bauch*

ABSTRACT

Some of the educational problems associated with limited resources, remoteness and lack of trained teachers can be approached by combining "off-the shelf" technology to give young children a better start in their education. The nature and quality of the first years of education is critically important to the social, academic and economic success of the children and the society. Hybrid applications of computer-based instruction with interactive video and other instructional media can be used to offer quality early education in settings where other educational delivery systems are not available or feasible.

THE PROBLEMS

The initial educational experiences of young children make a major and enduring contributing to their later educability and success in life (ref 1). If early education is of high quality, there is not only a growth in human capital but a significant economic saving to the society. Schweinhart and Weikart (ref 2) and others have found that funding a high quality program of early education can produce savings of up to 600% over the initial investment. When Saks (ref 3) reviewed the economic benefits of good preschool programs in 1984, he found that an investment of $1600 per child per year produced over $5000 in benefits to the child and more than $18,000 in savings to society. These findings are particularly relevant to children from less than optimal home and community environments; the children of the poor.

In most countries with underdeveloped educational resources, the youngest children of undereducated parents that are remote from urban centers are not likely to receive high quality educational experiences. Their first few years at home are spent with parents and other adults who themselves have very limited educational backgrounds. When most of the children in the more developed nations begin to attend quality preschool programs, young children in less developed nations usually have none. Their entrance into primary school presents them with an unresponsive curriculum provided by poorly paid and poorly prepared teachers, and they are unlikely to develop a permanent motivation to achieve in these circumstances. School leaving, even before the completion of the first six grades, is very high (ref 4) The distance from urban centers is another factor that limits the quality and availability of excellent early

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education. Even the most marginally prepared teachers prefer not to be assigned in remote areas, where housing, transportation and other living conditions are rudimentary. Add to this problem the perception of many people that teachers of younger children need less training than teachers of older children, and you end up with few or no highly-qualified teachers to work with the children who need and can benefit the most from good early education.

This situation is exacerbated if you are not a member of the majority culture or language group. If the government does provide teachers and an educational program to minority cultural groups, it is almost always in the national or majority language. While it may be true that learning the majority language is a critical skill for economic survival, it is also true that the native language of the family is a powerful and important factor in the preservation of family and cultural values. (ref 5)

A PLACE FOR TECHNOLOGY?

Is there a way that microcomputer and other instructional technology can be used toward solution of these problems? It is the premise of this paper that high quality learning experiences can be provided in remote areas to children with the greatest need with hybrid electronic teaching/learning systems.

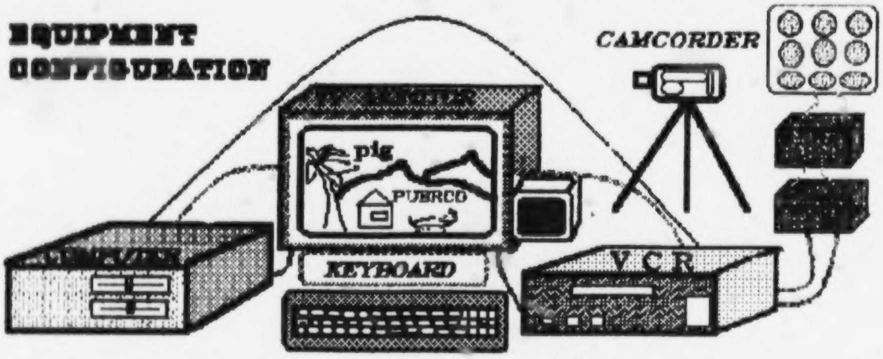
Some of the criteria for selecting and adapting equipment and programs are:

-- equipment must be durable and dependable
-- systems must be self-contained, and must not rely on external power sources
-- the best educational principles must be followed in designing the instruction
-- the child's local environment is an excellent source of curriculum content
-- early education should be sensitive to the family and local community values and culture
-- the equipment and educational program must be usable by local adults with no previous technical or educational knowledge
-- bilingual or multilingual instruction must be possible
-- content and concept learning is done best when viewed in a familiar and enriched context
-- children learn by interacting with multi-sensory stimuli

These criteria point to a hybrid system using solar power to run a microcomputer that controls both video and computer-generated instructional programs. They imply that instructional design be done by experts so that the programs can be implemented by local individuals with very limited expertise. The system will draw content from the immediate environment and present information in at least two languages. And it will be interactive and highly motivating too the children. Can such a system be built and used in remote areas? We think so.

EQUIPMENT AND POWER SOURCES

A typical microcomputer/monitor and VCR requires about 3-4 amperes/hour, which can be easily supplied by two deep-cycle 12 volt storage batteries. A solar collector of about one meter square produces enough current to keep the batteries at full charge, so the system could be used 4-6 hours per day. figure 1 shows a typical configuration.



The use of solar power to charge storage batteries is one option for power. Some solar modules are self-regulating so that battery power is retained whenever sunlight is available. Assuming that a system would be used for a few hours per day, a modest collection/storage unit would be adequate. Alternative power sources might be hydroelectric or wind-generation, or portable gas/diesel generators if available.

INSTRUCTIONAL PROGRAM DESIGN AND TESTING

The instructional programs can be developed to operate with alternative input devices, such as "joysticks" and even touch-screens. For the first trials of the system, it is recommended that a team of early education experts and people with computer and media expertise work together to create the basic programs. There are a number of authoring programs that prompt the developer in designing computer graphics and selecting video clips for import to the screen. The equipment should have speech-synthesis capability so that words or phrases that appear on the screen are also heard. Story format and problem-solving patterns are preferred over rote or pattern drills (ref 6). Other initial learning programs, such as Logo, have been used effectively in remote areas (ref 7).

In the first stage of implementation, a ministry of education or other organizational unit should design a series of instructional lessons using content and video from the target childrens' environment. The equipment and programs would be delivered and several local individuals (parents of the children would be ideal) would be trained to orient children to the system. Observation and data collection during the first trials will assist instructional designers in making program improvements as new units are developed.

After the first series is developed, a second series should be planned where original video material is taped in the local environment for use in new teaching programs. One or more parents can be trained to take video tape of the people, places and things in the immediate experience of the children. This video can be drawn into the computer-assisted learning program, and it is not inconceivable that some of the basic authoring of programs could take place at the local level with some technical support from outside experts. Generic learning programs that have broad application can also be converted to laser disk in the third generation of program operation.

SUMMARY

Young children who have limited access to educational opportunity in situations where trained teachers are not available could benefit from computer-based hybrid instructional systems if certain conditions are included. Interactive video and computer-generated learning experiences can be provided in bilingual forms, and can use content from the child's immediate environment in the curriculum. Solar, hydro or wind-generated power can be used where no current electricity is available, and the electronic learning system can become a focal point of community support for early learning. Family and local cultural values can be preserved by adapting generic instructional design to local content, and the costs of repeated use are very low. All children deserve a high quality early learning experience, and new electronic systems can serve as an effective delivery medium.

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A SOLAR-POWERED, COMPUTER-BASED EDUCATION SYSTEM : FUTURE HOPE FOR THIRD WORLD COUNTRIES*

T Stonier

ABSTRACT

Education is the most important economic activity any country can invest in. In the 1990s the possibility will emerge for Third World countries to develop full-fledged computer-based education (CBE) systems: Microcomputers will continue to become cheaper, as will associated hardware such as CD-ROM and interactive video. Photovoltaic cells could provide a cheap, reliable energy source, while software production will be greatly facilitated by powerful authoring systems.

INTRODUCTION

We live in a rapidly changing world. As the pace of change accelerates, education becomes more crucial than ever in providing people with the intellectual tools required for survival.

Human capital is the most valuable asset a country possesses. Physical assets, although helpful, are no guarantee of a country's future. A series of wrong decisions can cause a country which relies on its physical assets alone, to end up in oblivion. In the 1960s, demographers looked to sub-Sahara Africa as one of the few bright spots in the Third World. In contrast, South and East Asia were viewed with pessimism because of the ratio of people to physical resources. It was the emphasis on physical rather the human resources which led to the misassessment. The long-term economic future of a country is a function of its education system.

Even countries richly endowed with a particular resource (eg, Arab oil) would find that their high standard of living could disappear within a generation once the sources of finance dry up, or alternatively if an uneducated citizenry follows uneducated leaders into a major conflict.

TOWARDS A SOLAR-POWERED CBE SYSTEM

The inability to achieve an effective education system in many Third World countries usually involved one of three obstacles: Lack of finance, cultural barriers, and lack of good teachers and education managers. Instead of building schoolhouses which usually can only be staffed with third-rate teachers, forced to rely on rote learning under primitive conditions, Ministries of Education in the 1990s ought to look to solar-powered computer

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systems. Such systems would, initially, be placed in communal meeting places such as existing schools, churches, mosques, temples, government buildings, etc. Ultimately such systems would appear in all households (just as electricity).

Prior to introducing the solar-powered computers to villages, the government must : 1) create the administrative machinery to establish, operate, and maintain such a CBE system; 2) institute training programmes -- frequently using computer-based training (CBT) packages -- to teach people how to set-up, maintain, and utilise such a computer-based education (CBE) system; 3) have developed sufficient quality software.

1. Costs : Computer hardware costs will continue to come down. So will associated systems such as CD-ROM and interactive video. Small solar panels for generating electricity are now widely used in the marine industry for powering navigational equipment on sail boats. The core, the photovoltaic cells, are becoming cheaper each year. So are batteries.

The capital costs of installing solar-powered computers must be compared with the cost of building schoolhouses and other related facilities. The running costs of a CBE system must be compared with the salaries and maintenance costs associated with operating a traditional education system. It may well prove that a CBE system is not cost-effective in certain urban situations, but may be highly effective under rural conditions.

2. Software : In contrast to the increasing quality and cheapness of application software such as wordprocessing packages, good quality CBT and CAL software is still in short supply. However, application software is becoming increasingly important in all forms of education. The most important use of computers in primary and lower middle schools in Britain involves utilising the computer as a wordprocessor, and as a database manager. Furthermore, the software situation will have changed by the mid-'90s: We are currently witnessing the emergence of increasingly powerful and easy to use, authoring systems. Such systems are making it simpler, not only to generate new CBT or CAL packages, but to modify existing programmes so as to fulfil curricula, linguistic, or other learner requirements.

3. Systems experience : By the mid-1990s there should exist a sound empiric base for moving towards CBE: This will be based, in part, on the Western trend to "distance learning" to fulfil the need for mid-career retraining, in part on the substantial experience of institutions such as the Open University. There is also the experience already gained in the use of computers by certain Third World countries.

4. Training : Initially, many Third World educators may need to learn from their Western colleagues both the art of using computers in education, and how to develop distance learning systems based on CBE. However, once the administrative and institutional infrastructure is in place, the system becomes self-perpetuating. Its growth becomes limited only by governmental (or other) support. Properly training the administrators, village elders or teachers, support staff, and the children themselves, is as important -- probably more important -- than the purchase and placement of computers. The process will follow the classic rules of technology transfer : an educated workforce learns to exploit the new technology (in contrast, an ignorant workforce becomes its victim).

BENEFITS

The advantages of using computers as learning tools have been summarised earlier (ref 1).

1. The computer is interactive. Unlike books, tapes, films, radio, and even television, the user is engaged in motor activities -- not in a passive exercise. Even simple, linear CAL packages provide the illusion of a sense of control for the naive learner.

2. Computers are fun. Human beings love to respond to challenges and make things happen. The computer games industry has grown rich by catering to this desire.

3. Computers have infinite patience. The computer doesn't care how often a learner makes a mistake. It never gets tired or cranky.

4. Good education programmes provide effective positive reinforcement. They never put a child down.

5. Computers provide privacy. Ignorance, lack of skill, slowness to comprehend, poor coordination or other handicaps -- learners can make embarrassing mistakes without anyone seeing them.

6. Paradoxically opposite to N^{o} 5, the computer can be used to stimulate a variety of social interactions. These include classroom activities involving groups, or a teacher and a single pupil, or two neighbourhood children, or a grandparent and grandchild, etc.

7. It becomes possible to have alternative pathways in a program so that some aspects remain hidden to the learner, only to be discovered accidentally on certain occasions. The element of surprise can be a strong motivational factor helping learners explore a subject.

8. Animation can explain concepts in a more interesting and understandable manner. No amount of talking, writing, or providing diagrams can compare with making things come alive on the screen.

9. The ability to simulate complex situations such as ecosystems, demographic or economic changes, is a particularly powerful reason for using computers in training chemical engineers, pilots, doctors, managers, that is, any profession or activity where a mistake in the real world could be very costly.

10. The computer allows "real time", ie, instant responses. This is as true for programming a remote LOGO turtle, as it is for transmitting information from one instrument to another across a room (or a country).

11. This ability to communicate instantly allows a system of electronic pen pals and education colleagues to merge across a country, even across the world.

12. If a child learns to programme a computer, the computer becomes a powerful intellectual experience fostering habits of logical thoughts.

13. The computer can learn from the child. Advanced "expert systems" ascertain the student's level of competence in a subject, then react to the student's questions and answers at an appropriate level.

14. The ability to put material into a variety of contexts, visual and experiential is crucial to helping the learning task. For example, when learning a vocabulary either in one's own or another's language, to associate the words with pictures particularly if those pictures have been generated by the appropriate spelling of the words, is an enormously powerful mnemonic system mimicking the way children learn a language naturally.

15. All of the above combine to provide custom-tailored education : "Hello Jane, what shall we do today?" can be followed by an infinitely patient, friendly, entertaining set of programs catering specifically to the learner's interests, capability and needs.

CONCLUSION

Solar-powered, computer-based education systems will become substantially more cost-effective than traditional education systems, particularly in Third World countries with large rural populations. A CBE system would allow Third World countries to provide new, more powerful learning environments.

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THE BRAIN DRAIN: AN INTERNATIONAL DEVELOPMENT PERSPECTIVE

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ABSTRACT

The concept of the brain drain has traditionally included only expatriate students but has recently been expanded to include practicing professionals. Many countries, concerned about the loss of these expatriates, are attempting to deal with the brain drain by limiting student study abroad and emigration. Evidence suggests that the brain drain, for most countries, is not a significant factor in national development. Some countries use the brain drain to mask political and ideological motives. The brain drain exists when there is an imbalance between a nation's ability to absorb highly educated people into appropriate employment. Nations should redirect their concern from the brain drain to a "brain plan" to improve their use of highly educated people throughout the world.

INTRODUCTION

The traditional definition of the brain drain involves students who study abroad with the expectation that they will return to their native lands but who then elect not to return home. A new definition of the brain drain has recently been developed by brain drain researchers at the Institute for Advanced Administrative Studies at Syracuse University. This more comprehensive definition includes "the departure of highly trained people from a specific social context--be it a country, an organization, or an occupation--as a result of frustration from not having opportunities to fulfill professional aspirations in the given social context (ref 1)." The focus of this paper is upon the traditional type of brain drain involving expatriate students and one of the newer types involving the exit of practicing professionals from their homeland.

The phenomenon of the brain drain deserves the attention of those in higher education as many students study in countries other than their own. In the U.S. more than 350,000 foreign students studied at more than 2,500 colleges and universities during 1987. Because the top three fields of study of these foreign students are engineering, business/management, and computer/information sciences (ref 2), technology educators play an important role in helping these students contribute to world development as development is technology driven. Because some of these students do not return home or leave home once practicing professionals, many nations are demonstrating concern about the loss of these expatriates. This paper explores the issue of the effect of this brain drain upon national development.

THE BRAIN DRAIN: REAL OR NOT?

Interest in the brain drain issue first peaked in the mid-seventies. As a response, the U.S. State Department surveyed seventy-six U.S. embassies about the effect of students who failed to return home after study abroad. The fact that only sixteen embassies believed local governments perceived the brain drain as a problem seems to imply that there was not much of a problem (ref 3). However, times change and interest in the brain drain

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has mounted again in the late eighties.

A recent report serves to illustrate the newly resurrected interest in the brain drain. An announcement by a Chinese official originally published in a local Chinese newspaper stated that a drastic reduction would occur in the number of government-sponsored students sent abroad. The official did not have an explanation for the cut from 6,000 to 500 students but expressed the belief that it was because the great majority of Chinese students abroad are unwilling to return home. Later another official denied this reduction, but reports persist that China might enforce limitations on the duration and other aspects of study overseas (ref 4).

Another indication of interest in the brain drain issue is a recent study by the United Nations Subcommission on Prevention of Discrimination and Protection of Minorities. This document was drafted under pressure from the East Bloc and Third World sources. It presents arguments for the need to avoid the brain drain from developing countries as justification to limit emigration. Many such countries exhibit concern about the brain drain by attempting to limit its effect by curbing the basic human right to emigrate. A 1984 study by the United Nations Conference on Trade and Development estimated that about 500,000 professionals left Third World countries in the postwar period. The chief cause of brain drain in developing nations appears to be lack of employment opportunities (ref 5).

So just how real are the brain drain concerns of China, the Eastern Bloc, and Third World Nations? Regarding the traditional type of brain drain, researcher Paul Pedersen of Syracuse University, claims that the fear of a brain drain is "one of the strongest arguments" made against sending students overseas for higher education (ref 6). Attesting to the effect of the newer type of brain drain, a Nicaraguan official recently commented regarding the flight of the nation's accountants, engineers, and doctors. He stated, "This brain drain is the worst kind of decapitalization the country has suffered (ref 7)." Admittedly, many lesser-developed nations have long endured exploitation of their choicest natural resources. Such nations might have legitimate concern then about protecting their human resources for future national needs. However, evidence suggests that these nations are acting on the basis of political and ideological motives.

THE BRAIN DRAIN AND NATIONAL DEVELOPMENT

A study by Myron Weiner of MIT (Massachusetts Institute of Technology) showed that of the eight countries with the highest levels of emigration during the 1960s, five had above-average growth rates; so did seven of the top nine in the 1970s. In the Fifth U.N. Population Inquiry of 1982 only twelve nations of the 109 surveyed indicated that emigration negatively affected development (ref 8). If these existing patterns continue, no strong justification appears for nations to limit emigration on the basis of development needs.

Concern about the brain drain, however, is not limited to only lesser-developed nations. Two of the most highly developed, the U.S. and Japan, also have vested interests in the brain drain issue. The concentration of Japanese scholars at the most elite U.S. educational institutions, such as MIT and University of California at Berkeley, have caused some U.S. business and government officials to be leary of Japan's motives. An example of this possibility is illustrated by the testimony of the chief executive of NEC. He recently wrote in an MIT publication how the company enjoys a leadership position in voice-recognition technology as a result of a NEC researcher studying phonetics at MIT. U. S. officials fear that Japanese students will gain such technologically advanced ideas from the many university-industrial partnerships, thus depriving the U.S. of any advantage in the race for technological supremacy with its accompanying economic power (ref 9). University officials, however, defend the presence of Japanese students at U.S. institutions on the basis that most research is eventually published. From the Japanese perspective, there is no brain drain. The experience of Japan reflects the findings of many brain drain studies; namely, when a reasonable balance exists between the number of professional graduates and employment opportunities, countries have little difficulty with brain drain (ref 10).

One recent initiative by the U.S. demonstrates how a nation can take positive steps to counteract brain drain. Legislation expanding immigration criteria is currently pending in the U.S. This new bill would enable individuals with education and talents considered in short supply to receive preferential admission status. On the other hand, an equally viable opportunity to increase the number of desirable professional talent in the U.S. was recently lost. A new federal program called the Cooperative Association of States for Scholarships provides scholarships to foreign students for study at U.S. colleges and universities. A stipulation of the U.S. scholarship program, however, is that scholarship recipients must return home following completion of their studies (ref 11).

Declining numbers of U.S. citizens are seeking doctorates in mathematics and the sciences, but increasing numbers of foreign nationals are taking their place. Currently, foreign nationals earn about 60 percent of U.S. doctorates in engineering, 40 percent in mathematics, and 30 percent in physics. The participation of these foreign nationals as teaching assistants and professors enables U.S. universities to educate their students in the sciences and engineering (ref 12).

Of course, the U.S. should not abandon its efforts to encourage more of its citizens to study mathematics and the sciences or come to rely on foreigners for its development. However, a consistent "open door" policy regarding desirable foreign nationals would help to alleviate the current shortages.

CONCLUSION

The position of this paper is not to suggest that the U.S. or any other nation become "brain hunters" of foreign students or practicing professionals in order to bolster national development. Evidence suggests that the current level of brain drain is not seriously impeding world development. Nations that attempt to limit the study of their students abroad or limit emigration as methods to curb the brain drain are acting under political and ideological motives. Individuals do not abdicate their cultural identities on a whim but only for the gravest reasons. A 1979 World Health Organization study stated that "When a country reaches the point where it can afford its expatriates, most are likely to return of their own accord, given that ties with family, culture, and homeland are not easily broken (ref 13)." Professor Pedersen, the brain drain researcher, makes a good point when he states that the U.S. and other nations need to move away from a concept of the brain drain and move toward a "brain plan" for improving the use of highly trained people throughout the world (ref 14).

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TRAINING ADULTS TO USE SOLAR-POWERED COMPUTERS FOR LANGUAGE TRANSLATION

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ABSTRACT

Native translators in the Caribbean, Central and South America must incorporate the use of solar-powered computers to input Bible text in their own languages.

Basic training in computer usage, with a "developmental research" approach, occurs in five-day workshops. One day is set aside for policies and standards and pre-assessments of learning habits. In the next few days translators learn the mechanics of input by using standard codes compatible with typesetting, proper computer management, diskettes, files, and printer. The fifth day is for evaluation and review. This "hands-on" strategy presents very satisfactory results even after a few hours orientation.

During training it is important to prepare "ad-hoc" step-by-step procedures, flow charts and/or procedures for translators to follow after the workshop.

INTRODUCTION

Significant changes in adult teaching strategies have taken place to include the computer into the process of translating and preparing an electronic manuscript of the Bible for typesetting. Traditionally this necessitated 17 to 20 years. Today the time is an average of 7 years.

To incorporate a computer to the translation process the Computer Assisted Text Processing (CATP) Consultant must:

1. Evaluate the location and human resources and recommend the adequate equipment. (Conforming to import export regulations of each country.)
2. Prepare objectives and teaching materials. Train native translator to use the computer, disk drive, printer, diskettes and file management. Train native translator to input text with markup codes for typesetting.
3. Evaluate the results of training workshops and resulting text.
4. Reinforce or correct the applied methodology and/or input techniques.

1. GEOGRAPHY, CIRCUMSTANCES AND SOLAR-POWERED COMPUTERS

Under the supervision of missionaries, groups of natives translate the Bible in different areas of the continent. United Bible Societies CATP Consultant investigates the geographical, social, economical and learning conditions of each team. Native translators are literate in Spanish, Portuguese or Dutch and their native language. They are selected among several candidates trained in translation.

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Translation of the Bible to a language never translated before takes place where the language is actually spoken. Therefore translations and training takes place in remote villages. In the high Andes in Ecuador, the Chaco in Paraguay and Argentina, the border of Nicaragua, Netherlands Antilles, Surinam, Haiti and other isolated areas.

Solar-powered portable computers are recommended when a combination of the following conditions is detected:

1.1. The translator lives/works where there is no or frequently interrupted electric power and/or no voltage stability.

1.2. Observed behavior in cognitive domain classify potential trainees in the six taxonomic categories (Bloom and others, 1956; Krathwohl and others, 1964) as:

Low in knowledge of: computer terminology and specific facts, ways and means of computers, computer conventions, sequences in word processing, classification of Bible format related categories, word processing and coding, universals and abstractions, principles and generalizations in the field of computers and text processing.

Relatively high in comprehension: translation from Spanish to their own language, interpretation of essential aspects of translation related matters, extrapolation of implications and meanings in the translation of the Bible.

Medium to low in application: organization skills, classification habits.

Relatively high in analysis of: elements of translation, analysis of relationships of computer parts, relevance of computer equipment in the translation process, organizational principles as techniques, forms and purposes of word processing.

High in synthesis or production of: structured written materials, derivation of concepts, discoveries, development of generalizations.

Relatively high in evaluation of: computers, printers and word processing as efficient means for text production, economy of time and efforts by using computers, importance of standards and sequential course of action.

1.3. The translation project budget for equipment is low (US$1,500).

THE SOLAR-POWERED EQUIPMENT

The components of the Solar-Powered Computer Equipment for Translators of the Bible are:

- Solar panel (9 X 5.5 X 0.2 inches)
- Power Cable (connects computer to solar panel)
- Charging Cable (used to recharge batteries with solar panel)
- Two DC 6 Volts/2.6 amperes hour capacity, lead-acid Battery packs
- Disk Drive (according to geographical distance to a CATP Center and also operated with battery)
- Dot matrix small Printer (according to electric power)

2. TEACHING MATERIALS AND TRAINING STRATEGIES

The design of materials and the training methodology follows a "developmental research" approach. That is "transforming experiments" where the experimenter is a part of the system he/she is seeking to understand and transform. Also each instructional situation or educating process is recognized as unique and considered as a dynamic transformational opportunity for the trainees.

> "Development refers to growth, not just final packaging of a fixed idea, and includes the process of initiation, modification, and recycling. Through gradual refinements over a period of time, a truly useful education approach can be introduced that may be a far cry from the starting point which catalyzed the entire chain of events."(Kean and MacNamara, 1978, p.162)

The base for this methodology is the conviction that what education needs is scientific inquiry to gather systematically observed empirical evidence about the process of educating in the natural world.

> "The purpose of developmental research is to use the scientific methods of systematic observation and analysis, including the powerful tool of experimentation, to guide and create desirable social forms."(Sanders, 1981, p.12)

Centers of Computer Assisted Text Processing were created in Mexico, Brazil and Ecuador. The purpose is to provide local educators (native instructors in this case) with both psychological support and technical assistance in the conduct of their experiment/inquiry. They should avoid excessive reliance on external consultants, and concentrate in building a learning community of educators in various locations.

> "Finally, developmental research could provide a mechanism for intelligent human participation in the design of educational forms compatible with the reality of social evolution. To ignore its promise would be to neglect a viable path for the future of education" (Sanders, 1981, p.13)

EVOLVING MATERIALS AND INSTRUCTIONAL OBJECTIVES

Materials (in Spanish and then translated to other languages):
- Manual for TANDY 100/102 users. Includes Glossary, file management tips and explanation of each key on the keyboard.
- Manual for Computer Basics, (computer literacy). Includes Glossary.
- Spanish Bible (Popular Version(VP), 1983) to follow text format
- Samples of electronic Bible manuscripts in Spanish (VP, 1983)
- Samples of progress control using the application called SCHEDULE ORGANIZER on the TANDY 100-102

The definition of Instructional Objectives is in behavioral terms for cognitive and affective domain. Three main levels were detected:
a. No computer literacy, high motivation
b. Some computer literacy, high motivation
c. No computer literacy, low motivation.

Example of cognitive and affective domain instructional objectives for level a. trainees:

Given 3 hands-on hours with the TANDY 100-102 the trainee will:
Cognitive domain:

- Recall, recognize and identify on the TRS80-100-102: the 4 switches of the computer, 8 function keys, 4 command keys, the cursor movement keys, 11 computer/typewriter type keys of the keyboard.
- Distinguish effects of different keys on writing/editing text
- Choose and correctly use each key of the computer in text processing
- Distinguish and contrast the functions of each key
- Produce a text using all keys
- Decide on which keys to use to economize time and efforts on input and editing of text

Affective domain:

- Differentiate between handwritten/typewritten and word processing time consumption in electronic manuscript preparation
- Combine given examples to improve text input procedures
- Follow directions on how to use computer for text input
- Spend leisure time to use the computer for text input

Training activities to reach objectives:
In 24 hours the trainees will:

- Read Glossary of Manual(s).
- Turn computer on and off and use and review functions of each key.
- Input and edit text using all keys.
- Produce a Bible chapter correctly coded and using keyboard features for word processing.

THE FIVE-DAY WORKSHOP

During the first day translators receive information on policies and regulations of United Bible Societies. They receive training on the standard markup codes they will use. They also respond to a questionnaire.
A typical pre-assessment of prior knowledge in computers and learning habits reveals:

- Most trainees have no background in computers or typing.
- Trainees have been away from a classroom for periods up to 35 years.
- Trainees have low recalling capability and retention span.
- Trainees have a high motivation/willingness to receive instruction in computers, to accept standards and procedures and to commit themselves to the translation/text input process.

During the following three days the instructors direct the activities designed to reach the objectives for the specific trainee's level. Trainees form groups of 5 or less according to computer literacy level. Each trainee has access to a computer. During the teaching activities instructors write down the procedures for the trainees to follow when inputing text. Instructor employs trainees' own vocabulary for description of procedures.

3. EVALUATION

The last day is for evaluation and review. The trainees answer the same instrument used for pre-assessment and input a Bible chapter. Each trainee must criticize the workshop methodology and training materials. Groups meet again for a final review and to refine written procedures when needed.

4. REPORTS AND RECOMMENDATIONS ON WORKSHOP METHODOLOGY AND RESULTS

Instructors make a complete report on the Workshop and recommend procedures for the trainees to apply until the next training workshop.

Every change suggested by the trainees is incorporated to the instructional objectives and/or the teaching methodology and tested in the next workshop. The instructors at the CATP Centers receive copies of procedures left in different projects and geographical locations.

A comment made by the CATP Consultant after one of the first workshops: "The first day the translators were excited because we were bringing technology. After the third day, they said our gift was to show then how to use the computer. During evaluation they stated that the real gift was teaching them about learning processes."

TEXT ANALYSIS, TYPESETTING AND PRINTING

The text is transferred from the Tandy 102 to an IBM compatible PC, using the internal modem. Text analyses are subsequently performed. The codes converted to typeset tags. Scanned graphics are included. By using a desktop publishing system and a laser printer, a complete Bible can be printed in 48 to 60 hours!

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PLANNING FOR K-12 TECHNOLOGICAL CHANGE

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ABSTRACT

Rapid changes in technology make careful planning critical, especially in schools where resources are generally limited. Issues of staff involvement and ownership, professional development, community and fiscal support, standardization and compatibility are but a few which must be considered. This paper focuses on long range, strategic planning and short range, annual goals for infusing technology into the curriculum of schools.

INTRODUCTION

No one can negate the fact that the mission and structure of schools must change in a technological age. This need has been expressed through numerous reports in the United States such as the latest Office of Technological Assessment document *Power On! New Tools for Teaching and Learning* , Lewis Perelman's *Technology and Transformation of Schools* and the Governors' 1991 Report on Education, *Time for Results*. One of the goals of Mr. Gorbachev's Perestroika is the restructuring of Soviet schools, including an "informatics" curriculum (ref 1). The United Kingdom, Canada, Norway and many other countries have made national commitments to bring technology into the schools.

Although policies and regulations may be made at the national, regional or state level in your respective countries, the local educational unit is generally charged to implement them. To use an appropo American idiom, that's where the rubber hits the road! You may be in the position of being able to establish your own policies and goals, which is the case in most school districts across the U. S.... or you may have to formulate local objectives which adhere to national policy. Regardless of the circumstance, careful planning is essential.

James Rutherford of the American Academy for the Advancement of Science has suggested that "Our failures in the past have had to do less with overestimating the power of new technologies than with understanding the effort necessary to exploit that power." (ref 2). Perhaps the most important effort we can put forth to exploit the power of technology for students is systematic planning. The planning process is a complex endeavor involving two levels....Long Range or Strategic and Short Range or Annual Planning.

STRATEGIC PLANNING

Much has been written lately about strategic planning in the corporate world and some educators have adapted those principles and practices into models for educational change. The first step in this process is to assess where you are and where you want to be. A simple inventory can determine what is currently in place but the more difficult part of assessment is accurately measuring expectations for the future...what the mission of the school should be in a technological age. Dr. Christopher Dede of the University of Texas refers to this process as the "situation audit" (ref 3). What are the external expectations of your community, school board, state and federal authorities? The internal expectations of students, teachers and administrators are also essential if you are to secure commitment and ownership in the proposed changes.

After these issues are identified and prioritized, planning objectives and implementation strategies must be employed to give direction to the effort. Dr. Dede suggests five criteria that a planning objective must meet:

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- **Substantive Validity-Will it accomplish what is intended?**
- **Economic Validity-Will sufficient resources be allocated?**
- **Ecological Validity-Does it fit with the overall direction of the organization?**
- **Political Validity-Will all who must endorse or "sign off" do so?**
- **Motivational Validity-Does it have a "champion" and "critical mass" of committed others?**

Perhaps the best way to illustrate this process is a case history from my own school district. Nearly eight years ago it became apparent that technology was beginning to impact our community and school district. The Board of Education ask a group of citizens and staff members to investigate the impact of technology on curriculum. The specific charge was *to explore the impact of technology on the K-12 curriculum and assess its implications for instructional programs*. We did an assessment of the current situation which included microcomputer utilization, computer literacy, an interactive cable network, robotics and programming at the high schools and other applications of technology.

This was followed by meetings and discussion about our expectations for students in the twenty-first century. A major goal which came out of the study and was adopted by the Board as one of eleven instructional goals for the district was *to provide students with the knowledge, skills, and values that will allow them to function as productive citizens in a sophisticated society which utilizes technology and information processing extensively.* Five learning outcomes we hoped to achieve for all students in the district were also identified.

The report of the Technology Advisory Committee, issued in April 1983, was incorporated into the Board's ten year strategic plan for the district which was completed in 1985. It is nearly impossible to plan ahead ten years, particularly in a dynamic area like technology. So the administration was directed to design five year operational plans which addressed the ten strategic issues identified by the Board. One of those issues of course was technology. Instructionally our four areas of focus have been Telecommunications, Video Utilization, Computer Integration and High Tech/High Touch Balance.

There is one crucial step within the strategic planning model which I cannot emphasize strongly enough. If ongoing coordination of curriculum integration, staff training, equipment purchasing and installation is neglected, the effort is doomed to failure. In our district, that function is performed by the District Media Center and its staff. We have a Teacher Consultant for Instructional Computing, a Cable Consultant and a Video Specialist who are supported by an excellent maintenance and clerical staff. They are responsible for staff training, meeting with committees who are revising curriculum, supervising purchasing and installation of new equipment and providing daily assistance to teachers. In smaller districts or even at the building level, one person should be designated as the technology coordinator and given the time to perform these functions.

In addition, our Technology Advisory Committee meets monthly to exchange information and review proposals for new projects. The committee deals with administrative as well as instructional technology to insure compatibility and adherence to our strategic plan. This is especially important as we begin to develop our district-wide communications network which will be used by teaching staff and administrators. Such a committee makes sense even at the building level in the case of large schools.

Long range goals are very important but can often get lost in the daily press of job responsibilities and problems. That is why the second level of implementation is so important...annual or short range planning.

ANNUAL OBJECTIVES

Obviously the people within the organization who must carry out implementation activities should be involved in determining the annual objectives. These objectives are set within the context of the strategic plan...a dynamic, synergistic process where annual objectives feed the long range plan which sets the direction for annual effort...a circle if you will. In our district, principals and media specialists are prime-movers in the effort to infuse technology into the curriculum. So each of them are given an opportunity to generate and rank media and technology program objectives for the coming year.

Examples of some annual objectives which have fed our strategic plan for the past four years follow:

- Develop a plan to provide adequate K-12 video resources.
- Continue integration of computing into the K-12 curriculum.
- Promote awareness and use of on-line information retrieval.
- Extend the opportunity to use I-TV to more teachers (BICUP)
- Expand the electronic mail system to more users.
- Negotiate dedicated I-Net channels with Booth Communications.
- Assist teachers with realistic integration of computer software into their curriculum.
- Explore linking schools & public libraries via the cable I-Net.
- Install and operationalize a satellite receiving link.
- Investigate the instructional value of video disc technology
- Explore instructional uses for the cable I-NET
- Secure funding for the Birmingham Integrated Telecommunications System (voice and data on cable)
- Secure funding for automated card catalogs and FAX machines
- Complete the computer articulation study began in early 1988 and report to Curriculum Council

These and several other objectives which addressed the High Tech/High Touch Balance goal have been achieved and contributed to realizing our Long Range or strategic goals. These goals (Telecommunications, Video Utilization, Computer Integration, High Tech/ High Touch Balance), and the implementation plans which support them, must be reviewed this year as we move into the next five year cycle and a new operational plan is designed.

SUMMARY

This is but one model for planning technological change in an educational setting. The process follows a logical, sequential path which has given direction in purchasing expensive equipment and more importantly, provided a road map for staff members in the district.

Long Range (Strategic) Planning

1. Conduct a needs assessment.....inventory what is and determine what should be
2. Formulate long range goals (major priorities), tentative plans & timetable.
3. Apply the Short Range Planning Process (SEE below) to implement.
4. Coordinate curriculum, staff training, equipment purchasing and installation.
5. Evaluate progress at the end of the timetable (5 years?) and recycle.

Short Range (Annual) Planning

1. Assess program strengths and weaknesses in an annual progress report.
2. Identify current problem areas, usually based on weaknesses specified in the above report, or areas in the Long Range Plan which need attention.
3. Prioritize (rank order) these areas with appropriate staff (ownership).
4. Formulate management goals and plans to resolve the problems or to initiate a change.
5. Involve staff, citizens and students in plans whenever possible.
6. Implement the plan of action.....activities, recommendations or proposals to others, etc.
7. Evaluate and report the results of your actions or efforts honestly; recycle if necessary.

I would like to close with another appeal for careful planning in a technological age. Some unknown pundit once said that most people don't plan to fail but do fail to plan. If we really believe that technology can empower people, enabling them to learn, experience or accomplish what they could not before...or better than before technology, then we have a responsibility to make that happen. Good luck with planning for technological change!

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TECHNOLOGICAL TRANSPARENCY: EFFECTIVE AND APPROPRIATE USES OF TECHNOLOGY IN EDUCATION

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ABSTRACT

As educational institutions accelerate their investment in technology it becomes increasingly important to use those technological devices cost-effectively. Such a use can only be realized when we have passed through the "gee whiz" phase into a condition of "technological transparency," able to look through the technology to its effective use in educating our students. Active student learning combined with application of a media concept implied in such new technologies as calculators, computers and teleconferences are the key concepts in achieving technological transparency.

TECHNOLOGICAL TRANSPARENCY

Today's education is marked by a wholesale acquisition of technology. The Department of This urgently requests 37 computers for use in its laboratory; the Office of That wants a classroom set of calculators; the Center for The Other Thing sponsors a teleconference for local business executives. Equipment is requested, approved, funded, ordered, delivered, installed. However, merely having the equipment does not guarantee that learning will take place or that the administration of a program will be more efficient.

Education seems to be stuck in a "gee whiz" stage, where classroom demonstrations too often consist more of "look what neat things we can do" than of actually doing the neat things so our students can learn. Phalanxes of desktop publishing operations crank out reams of high tech junk mail. Some teleconferences could be done better on videotape or by a live presentation.

No one can deny the intrinsic pleasure of possessing and playing with technological toys, but cost-effectiveness requires that sooner or later the technology in education must become **transparent**. That is, we must learn to look through the hard- and software to the results we hope to achieve. When the "new" wears off, the technology must become merely a tool to help us achieve those results.

Properly used, technology can facilitate teaching and learning, by recalling two fundamental lessons. One is from the study of education, the other from the study of media. From education we must remember the importance of active (in contrast to passive) learning. As Anglin 1973 (Ref 1) says,

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> The acquisition of knowledge, be it the recognition of a pattern, the attainment of a concept, the solution of a problem, or the development of a scientific theory, is an active process. The individual ... should be regarded as an active participant in the knowledge-getting process.

For the individual student to become an active participant, the teacher must be more than an all-knowing vessel of knowledge injecting information into passive students. Instead, the student must become an "active participant."

A second fundamental lesson comes from the study of the media of communication: techniques that are appropriate to one medium may not be effective in another (Ref 2,4). Modern media can be divided into mass media and interpersonal media, and they differ widely in what they bring to and require from their audiences. Interpersonal media permit a self-paced, reflective attitude and require active, individual participation. Mass media on the other hand, particularly television, ask less of their audience and permit a collective but more passive participation.

Stunning technological advances in media have established a role for each in teaching and learning, but technological transparency involves fostering a more-than-usually active learning mode. This is particularly true with electronic media that easily permit (or promote) passivity. It is difficult for a "couch potato" to become an active learner.

Our focus here is on three technological innovations that are used and frequently misused in education: teleconferences, calculators and personal computers. In each case there seems to be an appropriate use of the "medium" and an active involvement of students.

TELECONFERENCES

Higher education in particular is making increasing use of teleconferences, many of which, unfortunately, consist of rather boring satellite broadcasts of the "talking heads" so often found on public television. Television, as we have seen, tends at best to be a passive medium, and it is crucial to take steps to ensure active participants.

1. Although the groups promoting teleconferences often provide some opportunity to call in questions by telephone, too often the on-site "host" is just that and no more. Instead, it would be better to have a person with expertise in the subject matter and the ability to involve local participants in group discussions.

2. Since most teleconferences involve advance registration, some kind of preparatory material ought to be made available to all participants, along with encouragement to read it.

3. Existing teleconference formats ought to permit a more free interchange, perhaps through electronic mail or FAX.

Questions could be answered at the end of the original teleconference, in the course of a follow-up question/answer teleconference, or responded to in writing. In any event, the goal would be to transform what is currently primarily a passive experience into an active learning experience.

Less obvious but still true, a classroom is a medium of communication, located somewhere between the mass medium of television and the interpersonal medium of one-on-one face to face communication. The lessons of active learning and appropriate utilization of the medium apply to classroom instruction using calculators and computers as well as to the teleconference.

CALCULATORS

While the student use of calculators remains controversial, mathematics educators are increasingly encouraging and even insisting upon their use in teaching and learning in mathematics and other subjects (Ref 3). The trend should continue unabated as programmable and graphics calculators become more widely available, inexpensive and able to do many things that previously could be done only with a personal computer. Even with the development of calculators that can be used on an overhead projector, one factor remains crucial to in-class use of calculators: the students must acquire a basic competence in using the particular calculator being used by the class, and more time is required to achieve that competence than one might think.

A personal example may illustrate the problem. The author's wife is an experienced mathematics educator, and has taught using calculators in mathematics classrooms from elementary through graduate school. She recently sat as a student of a teacher who was using a new graphing, programmable calculator to demonstrate a "content" point. The "teacher" taught calculator usage algorithmically, but so quickly that the author's wife (and about half of the other participants in the project) were totally lost. The problem quickly became apparent: those in the class who had not mastered the calculator in question invariably had trouble. The result was that the lesson's objective -- to use the calculator to teach mathematical content -- was not well met.

The solution also seems apparent: to acquire technological competence, the learners must have time to "play" with the technology with substantial hands-on experience. Most of us learned to ride a bicycle at an early age, and much of our ability to ride now is found in our motor skills. Why not apply the same approach to calculator usage and supply our students with sufficient time to "let their fingers do the learning." But given constraints on classroom time, how does one provide the time?

1. In-class. A teacher might structure the content so that earlier lessons provide both content and technological

instruction. That is, one might change lesson plans in order to aim toward achieving both ends simultaneously.

2. Out-of-class homework. This requires, of course, that the students have access to the calculators, but if it is possible to supply them, homework exercises could provide the opportunity for achieving competence.

3. Directed lab experiences. In situations where the students cannot be supplied calculators, and where they cannot be expected to buy them, out-of-class (perhaps after school) lab sessions are often possible.

THE PERSONAL COMPUTER

Computers, too, involve time and hands-on learning, but even schools well equipped with calculators may lack computer facilities, and those may often to be unavailable for student usage. A typical school might have one computer and large monitor in the classroom and a small lab with individual computers for student use. Once again, active learning and appropriate media utilization are necessary.

1. In-class demonstrations can be combined with directed laboratory experience. In-class demonstrations must actively involve students individually, perhaps through discovery learning and/or asking the students to predict, say, the location of the next graphed line or the next solution to the equation.

2. Liberal use of handouts is in order, including one that diagrams the keyboard of the computer used in the class so students can see which keys are being used.

3. Many schools are equipped with devices that permit the computer screen output to be projected on an overhead projector. In-class use of this device is recommended, if not now, then after much-needed improvements are made in the quality of the projecting devices. Teachers should be particularly careful to see that the relatively small characters are viewable throughout the classroom and, if necessary, use 40 character display modes.

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AN ALTERNATIVE LEARNING STRATEGY: THE ANSWER TO A PROBLEM WHOSE TIME HAS COME

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ABSTRACT

The author of this paper has previously argued, at European conferences in Paris (October 1988) and London (November 1988) that existing approaches to vocational education and training are time-expired.

Present structures are provider- and not learner-centred. They are rooted in geographical and political structures that technology has discredited. The future requirements are for multi-media scenarios that are effective and efficient, and (above all) recognise that direct teaching is only one element amongst many others in a package that should be susceptible now only to output- (not input-) measurement.

There are implications for staff - and for buildings. Above all, there are requirements for technology-based learning management and assessment programmes. The provision of training at all levels (from individual to multi-national company) has to be achieved against real-world business criteria. TBT must change gears.

There is a requirement for an Alternative Learning Strategy. This, it is argued, must be an international initiative in order simultaneously to satisfy first-phase cost restraints and the requirements for curriculum breadth.

BACKGROUND

There are about 650 colleges of further education in the United Kingdom. There are also over 5000 secondary schools providing education for the 14-18 age-group of which more than half are both in the public sector and providing post-16 education and training opportunities. These and the FE Colleges are linked through the common strand of our Technical and Vocational Education Initiative, which is part-sponsored by national government.

The present method of responding to need in and around this common strand (or curriculum 'spine') is both costly and inefficient. In many respects it is ineffective. It is also bureaucratic and too much reliant on either short-term or local priorities - or both.

Worst of all, the present structure is provider- and not learner centred. Indeed, the consumer (whether it is the individual trainee, the training manager or the company director) gets a uniformly bad deal; there is a dearth of feed-back mechanisms and little if any attempt to provide genuinely flexible training responses to perceived needs.

The alternatives to the teacher-led (more accurately, teacher-dominated) scenario characteristic of UK provision currently have not been very successful. Either the applications have themselves been flawed (using computers in areas where they were significantly user-unfriendly, making the worst of poor quality courseware, locking in to hardware that is expensive, slow and not susceptible to uprating) or they have focussed on only one sub-set of the available technologies to the exclusion of all else.

This is not good enough. Technology-Based Training (TBT) is much more than an eclectic collection of disparate technologies - it needs to be a co-ordinated **approach to training which is based on open learning and open access.** It is of course much more even than this, with "ownership and control" of the learning process being increasingly in the hands of the customer. The philosophy merely permits open opportunity and access - the technology facilitates a radically different approach to the delivery of training.

There is now an important credibility gap between the promise and practice of TBT which is seen to have promised much and delivered little. Public sector Further Education in UK, like many private sector training departments, has resisted TBT because of sectional (manpower based) interests. This is wrong. **The arguments for TBT approaches** are well rehearsed and become even more attractive within a **national strategic training initiative.**

THESIS

What we need is a comprehensive **Alternative Learning Strategy**. Certainly we need a strategy. That strategy needs to be comprehensible to a wide audience and it needs to be comprehensive. We, as training professionals need to take a lead in its construction. We need to spend time and effort on anticipating a new training era and in focussing on client needs.

It is really no longer possible to believe that our conventional system will cope with the national needs for education and training into the next century. This is true both at the point of delivery and in terms of the management infrastructure. Nowhere, to take a particular case at issue, have we utilised the power of that technology of which we already are the master. To put it crudely: **this technology already makes many teachers, the Local Authorities and most of our bricks-and-mortar institutions obsolete in the next ten years.**

The costing arguments are clear. Technology-based training (TBT) is front-end loaded; there are comparatively high first phase costs. Even though we still use the wrong cost-effectiveness indicators to measure the worth of conventional training and fail to undertake any longitudinal cost-benefit analyses (which means that the poor and the shoddy escapes unpunished and is sometimes rewarded) it is obvious that a major leap forward in the utilisation of TBT will lead directly to a significant drop in the unit costs of successful training programmes. This contrasts with levels of necessary funding for traditional systems of training which inevitably increase.

Open Learning, whether it is a strategy or a programme, a structural development initiative or the catalyst for change in curriculum delivery, needs to be seen as part of a total approach to the provision of training opportunities. It is no more an answer by itself to the problems which confront us than is the conventional teacher-led scenario to which it is superior not least because it genuinely focusses on learning rather than teaching, outputs not inputs, the receiver in preference to the provider, and accessibility rather than closed structures. But it remains no more than part of the solution to our national training problem. The challenge for us lies in the choice of appropriate strategies (and the best media mix) in a very wide range of training contexts.

Actually, Open Learning is not a very accurate title, although it is politically attractive. What we are really talking about is **flexible learning and training provision that is consumer- and not provider-led.** Colleges will need to make such provision their stock in trade. It will require them to reassess all their priorities - not before time.

IMPLICATIONS

What will it all mean? It certainly implies that:

- the **ownership of the learning process** must, once and for all, pass to the learners
- teachers, lecturers and trainers generally will become **aids** to that process and will be more or less important to it depending on the particular context
- the first-ranking subject for the investment of scarce resources must be the **new technology** which will deliver constant quality training at predictable (and comparatively low) cost
- we should rationalise the **conflicting demands** for maintaining a secure organisation on the one hand with clients' need for flexibility (thereby maintaining market credibility) on the other
- the **support roles** in the training process will be redefined: many teachers will need to become administrators while technicians will become active collaborators in the learning programmes
- **training institutions** will have to be managed as **businesses** and will be judged against the criteria of the industrial and commercial world
- restrictive practices of all kinds will find less, and eventually no, external support; people's jobs and the national well-being will depend on accessible opportunities for **successful self-managed self-development**.

There will be some very visible **outputs** from this change process. They will include:

- new inter-linked and **modular curricula**
- similarly new, inter-linked and **flexible accreditation structures**
- practical applications of **sophisticated technology** to the learning process but susceptible of use by the newest and most naive client
- brand new concepts of private sector **business ventures** operating in the public sector world of vocational further education
- volume production of good quality **CAL and ICAL materials** to more-or-less common standards (where cost will be a very important political imperative)
- much greater attention to **client care** - which will mean providing an integrated package in which accommodation, refreshment and leisure facilities will all play a part.

- an **after-sales** service to clients involving counselling, progress monitoring and feedback reporting.

Perhaps the major single output will be the radical review of what constitutes necessary and appropriate accommodation and, for that matter, what is considered to be the acceptable level of utilisation of the facilities made available. Where we do still expect clients to come to us - and, increasingly it makes better sense all round to take (or send) our service to them - we must ensure that we maximise the return on the investment we have to make in buildings and equipment. **Colleges will become communications and reference centres covering much broader geographical areas and having learning management and management information systems which will be almost wholly computerised.**

CONCLUSION

The **problem** which we are facing is a common one - a system which has been modified and "improved" over time to a point where it can no longer sustain the further major surgery necessary for continued life. Increasing numbers of workers need reskilling or upskilling opportunities at shorter intervals. These opportunities need to be provided flexibly, cost-effectively and in an attractive environment. They need to lead directly to a formal record of achievement that is incremental and portable. The present system will not deliver a product deemed to be satisfactory when judged against any (let alone all) of these criteria.

The **answer** is to disengage our focus (and the funding mechanisms) from the providing network. The new focus must be the outputs - the qualified national manpower resource and its reservoir of achieved skills and experience. The mission is to construct a programme from where we are now to where this new focus tells us we need to be. That strategic programme, in its implementation, then needs to utilise the best and most relevant of all the technologies (including direct personal teaching) in the optimum media mix. This implies the development of major new markets for hardware applications and will require fundamental shifts in funding structures.

A further **challenge** will be to recognise that these concerns are not particular to any one country. The single most important and least tractable block in all of this is in the availability (or, more accurately, non-availability) of high quality courseware across the vocational training curriculum. There is little point in establishing new delivery structures if there is nothing for them to deliver. It will be key to correct this critical situation in the immediate short-term. This could be very expensive; quality materials development work is heavily front-end loaded. The only alternative to greatly increased investment in training provision (unlikely) is a reduction in the national curriculum base (poltically unattractive) unless opportunity is taken for multi-national collaboration on a worthwhile scale. It is a truism that technology does not itself recognise national boundaries; it is more than time that we proved this truth to all our advantages.

DESIGN OF EXPERIMENTAL COURSES USING TELEMATICS

Bernard DUMONT*

ABSTRACT

The French Company of Electricity and Gas (EDF-GDF) is creating two courses for its employees, using telematics. One on "French expression and communication" and one on informatics. These experimental courses are focused on a possible organization of tools given to students to become more autonomous in learning. Telematics has been chosen especially for communication between students and between students and their tutor.

HISTORY AND PRESENT SITUATION

Since 1946, EDF-GDF is organizing courses for its employees on general and technical domains (ref. 1). Learning time is not included in working time and there is no obligation to follow any of these courses. Students receive written material and have to mail, regularly, homeworks to some teachers. The rate of giving up before the end of courses is very high, around 60%. There are about 9 000 students a year. A general study of the situation has been organized in 1987 for those "cours par correspondance". it has been shown that written documents are poorly linked with adults needs and that it's difficult to use them in an autonomous learning activity (ref. 3). Students don't know each other and don't even know their teachers. They feel isolated. The only educational aim seems to be the mailing of homeworks in time!

EXPERIMENTAL COURSES

Following this investigation, EDF-GDF decided to move from "mail-courses" to "at a distance" courses. Two such courses are presently developed, including telematics. The first one is called "Expression française et communication". At a low level of French, it is not only to teach elementary grammar rules but also to help students to express themselves in a correct language. The second one is called "Programmation structurée"using Pascal. It concerns technicians who already know something about computers. Both are following some fundamental orientations :

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- taking care of the specificity of the public : adults having a professional experience at EDF-GDF,
- building a set of tools (written papers, telematics, tutors) which is complete and self-sufficient for the learners,
- preparing students for an autonomous way of learning,
- focusing on learning and not on "correction" or evaluation (homeworks),
- considering tutors as a help for students without asking them to transmit knowledge.

These ideas are, indeed, very closed to those followed at Télé-Université (ref. 2 and 4).

THE ROLE OF TUTORS

Among all the possibilities offered in a distance course, the presence of human beings is very important, especially for beginners. But it's also necessary to precisely define their role. If written and audiovisual materials are well built, it's reasonable to think that all the information and all the contents of the courses is present in them. So, tutors don't need to teach, i.e. to transmit any knowledge. They have to take charge of the learners in a sense of helping them to work by themselves or with other students, to go through the entire course, to avoid any "blocking", to verify that material is correctly used. They have also to create links between students, to facilitate learning with peers, to activate students in their personal or group work.

THE ROLE OF TELEMATICS

In both courses, telematics is used as an electronical mail to link students to other students of a group and to their tutor. Tutors need to answer questions personally or, if several ones are identical, to give a general message insisting on this particular point. He has also to write a logbook of activities done, problems met with, ... In the course "Expression française", students are invited to use Minitel* (at home) to look for specific information (train schedules, phone numbers, ...) also to get familiar with this media (fig. 1).

In the informatics course, student will use Minitel for two more purposes (along with electronic mail) :
1) they will access a big computer to test their program in Pascal,
2) they will evaluate their knowledge through multiple choice questionnaires on Pascal language (fig. 2).

* Minitel is a small terminal which can be lent, free of charge, by the French Telecommunication Company (PTT) to everyone who has a telephone line. The cost is depending on the service you need : from 0 (phone number research) to 10 or more $ a minute (electronic mail, airlines or train schedules, ...).

Tutors working in the same course will be able to communicate with each other and to be in relation with their supervisor. The supervisor has both pedagogical and administrative responsabilities on tutors. He/she is in close relation with the conception team of the course, for possible corrections and changes in it.

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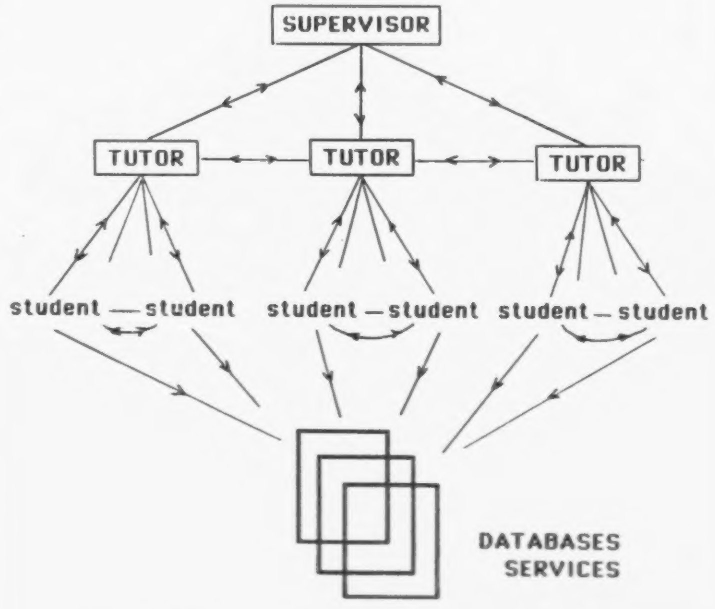

Fig. 1 : Telematic Network for "Expression française et Communication"

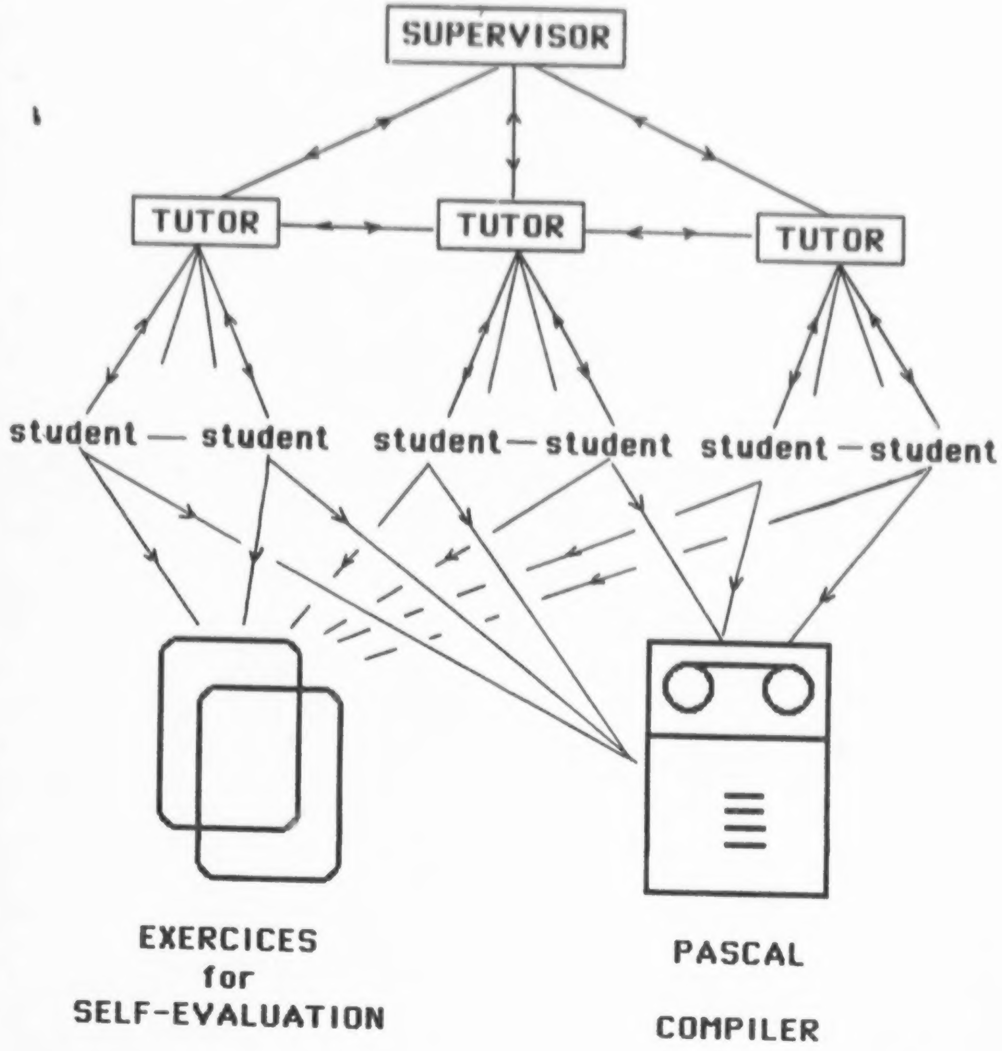
SUPERVISOR
TUTOR
TUTOR
TUTOR
student — student
student—student
student —student
EXERCICES
for
SELF-EVALUATION
PASCAL
COMPILER

Fig. 2 : Telematic Network for "Programmation structurée"

BUSINESS AND EDUCATION PARTNERSHIPS: NEW OPPORTUNITIES

D.A.Sachs

Businesses have an enormous need to provide education to their employees, and universities are ideal providers of such education. The Pace Computer Learning Center has provided almost 2,500 days of education during the past four years to over 15,000 corporate employees throughout the United States. Courses include short one and two day workshops in the areas of "PC Training" as well as longer and more substantive projects such as the recently concluded Graduate Telecommunications Program which consists of six graduate level courses provided to corporate clients.

These business and education partnerships provide benefits to all concerned. Businesses are able to have access to a highly skilled array of educational professionals who can share their expertise with corporate employees. At the same time, professors in a university environment are able to have "reality testing" of their theoretical knowledge. All are enriched by this process.

Business and education partnerships, or "The Learning Business" as Nell Eurich calls it, do provide exciting new opportunities for universities. This paper explores these partnerships from the vantage point of the work done during the past four years by Pace University's School of Computer Science and Information Systems and the Pace Computer Learning Center under the direction of this author.

INTRODUCTION

In 1985, the Carnegie Foundation For The Advancement of Teaching published an important book entitled Corporate Classrooms: The Learning Business. Written by Nell Eurich, this book describes in detail the results of her two year study of education being provided by corporations throughout the United States. As Ernest Boyer notes about her research, "corporate learning has become an absolutely essential part of the educational resources of the nation." (ref 1)

In 1984, the Pace Computer Learning Center was formed as part of Pace University's School of Computer Science and Information Systems. The Pace Computer Learning Center is comprised of approximately 15 full-time professors from the School of Computer Science and Information Systems. In addition, they are occasionally joined by professors from the Lubin School of Business. The mission of the Computer Learning Center is to provide corporate computer education in a timely and professional fashion. It is directed by this author, who is Assistant Dean in the School of Computer Science and Information Systems.

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SELECTED EXAMPLES

In 1985, when **IBM's Corporate Headquarters** needed PC education for many of its 4,000 employees who were working in Westchester County, they turned to the Pace Computer Learning Center. They needed, almost instantly, to have courses in word processing, database management, spreadsheet concepts, and graphics packages and they did not have the internal resources to provide all of the education which was needed in the time frame that was available. Working together with professors from the University, all of the courses were prepared according to their internal specifications, and then taught.

In 1986, when **Reader's Digest** needed to teach 100 employees the fundamentals of office procedures and MultiMate, they turned to the Pace Computer Learning Center. In conjunction with Reader's Digest Office Systems Support personnel, professors from Pace's Office Information Systems department and staff from the Pace Computer Learning Center, defined goals and objectives for the course, developed the necessary materials, and taught the one week course in a timely fashion to the Reader's Digest employees.

In 1986, when the **United Nations** wished to provide a course in Office Systems Procedures and Personal Computer education in word processing, database management, and spreadsheet concepts to 25 office managers in Jordan, they turned to the Pace Computer Learning Center. Working together with the UN personnel who were responsible for this project, the goals and objectives for the course were defined, the materials were developed, and the two professors involved went to Jordan for two weeks.

In 1986, when the **New York State Power Authority** wished to teach 15 of its employees the fundamentals of the "C" programming language, they turned to the Pace Computer Learning Center for support. One of our professors from the Information Systems department is a nationally known expert on "C" programming. She worked with the computer support staff at the New York State Power Authority to define their goals and objectives for this course, and to then provide the necessary education. Special projects were defined which reflected internal work being done at the Power Authority, and additional tutorial time was scheduled for those who needed it.

In 1987, when **Clarkson Industries** needed a series of PC courses for some of its high level executives, they turned to the Pace Computer Learning Center for support. Evening classes were scheduled, and the executives were able to learn the fundamental spreadsheet concepts that they needed to know. As one executive commented, "enough to be dangerous." Also, it became clear that it would be useful to provide some consulting work to develop a series of macros and menus to help consolidate the monthly statements which were being submitted by Clarkson's many divisions.

In 1987, when the Environmental Protection Agency began to purchase large numbers of personal computers, they knew that they needed help teaching their employees Lotus, DBase, and Word Perfect, since all of these software packages were being installed on the machines as they arrived. They turned to the Pace Computer Learning Center for help in defining their goals and objectives for their employees, and then delivering the necessary education.

In 1988, when IBM's Internal Telecommunications Group realized that it needed telecommunications education for approximately 200 of its employees, it turned to the Pace Computer Learning Center for support. As has been described in much greater detail elsewhere, the Pace Computer Learning Center faculty and staff worked closely with IBM personnel to develop and teach six graduate level courses which focus on the fundamentals of telecommunications education. These courses include Data Communications and Networks, Telephony and Switching, Computer Networks, Telecommunications Management, Policy and Environment, and Cases in Telecommunications. All of the courses have been carefully defined in conjunction with IBM personnel, and reflect both University and Corporate requirements.

All of these examples seem to support a recent survey done by PC Week, which proclaims that "The use of third-party services for microcomputer end-user training in corporations and institutions has increased dramatically within the past year." (ref 2) We are told that as of September, 1987, only 32% of all sites surveyed used third-party support for training; in September, 1988, this number had risen to 55%. It should be noted that this survey was conducted among more than 500 individuals in American corporations and institutions who are responsible for purchasing microcomputer hardware and software at their sites.

IMPLICATIONS AND OBSERVATIONS

In his introduction to Corporate Classrooms, Ernest Boyer states that there are several significant implications of this partnership between corporations and universities. He delineates five:

1. First, corporate education has important implications for business and industry itself;
2. Second, the corporate courses present a challenge to the nation's schools;
3. Third, corporate classrooms have implications for the methods and procedures of traditional education;
4. Fourth, corporate education raises important questions regarding the continuing education of adults;

5. Corporate education challenges higher education to clarify and reaffirm its mission. (ref 3)

The experiences of the faculty and staff of the Pace Computer Learning Center during the past five years support many of Boyer's assertions, specifically, his third and fourth points. Corporate classrooms do have implications for the methods and procedures of traditional classrooms. New technology, an attention to the detail and precision of the materials which are presented to students, and a rigorous attention to the evaluation of what is taught, all serve to challenge traditional university education. It is clear to all concerned, that professors who have been involved in corporate education programs such as those described above, have been challenged to be more attentive to detail, to be more concerned with the outcome of their classes, and to be more comfortable and competent with the new and emerging technologies which are often found in corporate classrooms.

In addition, corporate education does raise important questions regarding the continuing education of adults. We have found the adult students in our corporate courses to be highly motivated as well as quite challenging. Especially in some of the more technological areas, such as the Graduate Telecommunications Program, it is not uncommon to find students in the courses who know the content well; they just may not have the formal degrees to prove it. What we have also found is that, the adults in our courses are often inspired to continue their education, long after the corporate courses are over. Out of the first fifty students who have completed the recent Graduate Telecommunications Program offerings, almost twenty-five of them are either going to school or are planning to do so, so that they might finish their Masters in Telecommunications. Clearly, they are interested in learning more, and are even willing to do so after work hours, on their "own" time.

CONCLUSION

Business and education partnerships provide new opportunities for all concerned. They provide excellent, cost effective ways for corporations to provide the education that they need in a timely fashion to their employees. And they provide wonderful opportunities for University professors to immerse themselves in a corporate environment in which corporate professionals are actively putting theoretical knowledge into practice each day. All are enriched by this process.

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INITIAL TEACHER TRAINING AT A DISTANCE

D.K.Wright*

ABSTRACT

This paper discusses an important new development in Initial Teacher Training exemplified by the Physics with Technology Two Year Part Time Distance Learning PGCE Course from Brunel University, West London, UK.

INTRODUCTION

The Course was developed in response to a need discovered by the Institution of Electrical Engineers (IEE). The IEE, concerned about the increasing scale of the shortage of Physics teachers in schools, found that an appreciable number of their women members were interested in the possibility of training to teach in secondary schools. These members, many of whom were on career breaks, were unable or unwilling to make use of a conventional full-time teacher-training course because of family and other commitments.

Discussions between the IEE, the University Faculty of Education and Design and Local Education Officers followed and led to the proposal for a PGCE Course in Physics with Technology. Following their initial enquiries of their members, the IEE discovered that the interest also extended to a significant number of men members.

It soon became apparent that the demand for the course was not confined to members of the IEE. Although the majority of enquiries came from London and SE England, the course team decided at an early stage that, provided proper support could be arranged, students would be accepted from a much wider catchment than the home counties. The course is not a conversion course, as normally understood, so that students are Graduate Engineers, Physical Scientists or Technologists. Current student groups include students studying in Norway and Germany.

THE COURSE

The basis of the course was to be:-

- student lives at home, carries out school experience near home in collaboration with LEA
- all course materials provided on distance learning basis
- week-end and one day meetings arranged at roughly bi-monthly intervals
- tutorial support available by telephone and occasional visits to local groups.

Most of the course makes use of the written material from the Faculty. The design of the materials can assume that the students have met most if not all of the authors. The materials have followed five decisions

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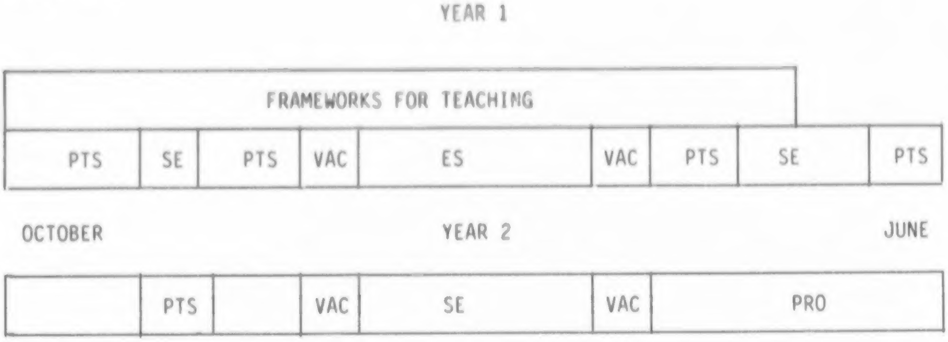
identified by FYFE (Ref 1): attractively presented; involve active learning; teaching as personal as possible; functions of materials clear; media input simple (none currently in this aspect of the course). However for these students a unit was much longer than Fyfe's suggested 3.5 hours work; the feedback suggests that the decision was correct.

One section of this material consists of Physics and Technology Teaching Studies which includes Broad Balanced Science. Each unit of the material focuses on a TOPIC, eg, Electricity, Waves, etc, and looks at the way in which this topic may be taught and the concepts and ideas learned in school.

The Open University approach using mainstream texts and tributary texts doesn't seem appropriate, since for Teacher Training Application all of the material has to be understood and grasped. The course, if it is to be successful, must give the students confidence and to that end each topic indicates most of the material likely to be met in school (11-18) with many questions, most of which are based on current popular school texts being used. Although many of these questions are apparently simple, the students accept them as an essential part of their armoury for helping learners in school.

The Physics Technology link is particularly important for this group of students, since many of them have important skills, knowledge and understanding from their experience as engineers. The importance of Broad Balanced Science developments in the 11-16 curriculum, AS levels and the changing nature of Technology are emphasised. Current and proposed developments in National Curriculum are essential points of any Initial Teacher Education course

Figure 1



PTS - Physics & Technology Teaching Studies
ES - Educational Studies
PRO - Project
VAC - Vacation
SE - School Experience

Practical work also occurs: some of which is carried out during visits to the University and some of which takes place in a local school. The latter requires a successful liaison between student and the school.

The Education part of the course is in collaboration with the Open University (Holmberg, Ref 2) and begins with the Open University Course EP228 'Frameworks for Teaching' which initially runs in parallel with the Physics and Technology contributions.

The second major part of the Education Studies Course is made up of five Units prepared specially for the course and in the main written 'in house'. The five topics covered under Educational Studies consider both the fundamental and recent developments in teaching. Where appropriate they have been related to the teaching of Physics and Technology. The first topic investigates firstly the value judgements inherent in teaching and secondly the nature of the knowledge we profess as teachers. The second topic adopts a psychological perspective in order to consider motivation, attention and perception, learning and memory, concept formation and intellectual development. The third topic examines assessment and its relationship to learning. The fourth examines one aspect of that whole process designed to ensure a closer fit between schools and the world of work. This topic discusses the extent and impact of TVEI on schools. The final topic focuses upon the fundamental classroom process of language, its nature, uses, development and the relationship between language and learning. Writing and reading are considered in the same way.

Students need to meet tutors who write materials, prepare themselves for independence in learning (Boud Ref 3), and have some hands on experience with school apparatus. There are two residential weekends and 3-6 days (according to the needs of the group) with these foci.

ASSESSMENT

Written assignments are used for the Education Studies and Physics and Technology teaching studies part of the course. The performance of the student teacher on school experience is assessed by a local tutor in consultation with a University Tutor.

It is already clear that some students under pressure revert to teaching strategies that were used on them. Current teaching/learning environments emphasise teaching strategies to enable learning with the teacher or by the learner. Mature students as teachers in training need to reflect on their approaches, there needs to be 'rebuilding and review' (Candy, Harri-Augstein, Thomas, Ref 4).

Students are expected to devote some 20 hours per week to the whole course. Initial feedback indicated that most students were spending longer than this on the written material and assignments.

STUDENT SELECTION

An interview would be arranged for a place on the course provided the prospective student was likely to be successful on the course and met the usual entry requirements. The interviewing procedure is more complicated than for a normal PGCE Course - each candidate being interviewed by the Local Authority Science Advisor/Inspector in conjunction with a University Course Tutor. This method is used to introduce the Local Authority to the Course and to enable discussions to take place, as well as ensuring that the student is acceptable to the authority. It is clear that students, although not given any expectation of employment at the end of the Course, would probably be employed by the same local authority represented by the Science Advisor/ Inspector.

As well as assessing within the limitations of the interview the qualities expected in a teacher, a definite attempt is made to determine the likely response of the candidate to returning to apparently simple ideas and equipment. It will be appreciated that the students are mature candidates, many of whom have been in positions of responsibility in industry.

SCHOOL EXPERIENCE

This is an essential part of any teacher-training course, an equivalent of 16 weeks is required. In our course there are 4 components:-

1. The Initial Observation concerned with the students observing classroom activities - for example, styles of teaching. The students are prepared for this by means of discussions during visits to the University as well as distance learning material. Each student is given a set of suggested foci so that the visit to school will fit into a well structured framework.

2. The second block of school of experience is a gradual introduction to teaching, beginning with small groups and progressing to full classes. Distance learning units help to prepare the student for this experience. Students can however expect to have their difficulties during this block so that strong guidance and support is necessary.

3. The third block lasts for some 10 weeks and is an assessed block. A student who is unsuccessful will not be awarded a PGCE. However problems should be apparent before the end of the previous block, so that remedial action can be taken.

4. There is, in addition, a project in the final (fourth) school experience. This project links the learning process in school with Physics and Technology.

Each phase of the experience has a preparatory introduction (eg 'Observation' for Phase 1) and an evaluatory phase, the latter being a crucial part of de-briefing (Pearson & Smith Ref 5).

EXPECTATION AND STUDENT SUPPORT

It is clear that a great emphasis is placed on the support of students on school experience, and this is particularly important during the second and third blocks. In order to prepare students, they are counselled in advance and guided by means of written material. Inevitably the day to day support is especially important and must come from the school, usually the appropriate Head of Department deputising for the LEA Science Adviser. In the event of problems requiring special support, the course tutors have to attend or communicate with the students by means of the telephone. Local group meetings are a necessary part of this support system.

We have already emphasised the link between the subject material and the preparation for the blocks of school experience; there is an additional link for practical work.

There are several specific problems in connection with the needs of the students and the nature of the course.

These points are apparent:-

a) As has already been mentioned, students frequently revert to their own experience as a pupil when forced with new material and stress.

b) A student may have a false impression of the degree of difficulty of a topic and may not appreciate his/her lack of understanding.

c) Students may feel isolated and insecure paricularly before their school experience blocks.

Although this course is not intended as a conversion course, we place great emphasis on the need to challenge the ideas already accepted by the student from their own experience.

THE FUTURE

Audio conferencing and normal video tapes are planned as part of this course, while interactive video is being considered as a possible development. An interactive video system would allow students to appear to visit the classroom perhaps during a practical session. Classroom problems could be incorporated so that the response of the student would affect the next stage of the programme. The main difficulties are those of initial cost in the making of the interactive video programme and the cost of the equipment required by the student. Inevitably programmes would have to be of short duration so that it would be uneconomical unless a) funding could be obtained on perhaps a national basis, b) local centres were available for the students to visit to view the programmes.

It is too early to evaluate the long term success of this course, this will only be possible when students are successfully teaching in schools on a long term basis. We are aware of the particular needs of mature students in this area and first indications are that these mature students with industrial experience will indeed make an important contribution to the Physics and Technology Teaching Profession. Proposed developments in Initial Teacher Training such as the Licensed Teacher Route to Qualified Teacher Status, suggest that some or all of the course material should have a wider application.

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DO PART-TIME STUDENTS LEARN MATHEMATICS BETTER WITH CAL THAN BY TRADITIONAL METHODS?

JEAN COOK*, SUSAN MILNE*, EDWARD SHIU*

ABSTRACT

Glasgow College offers a Bachelor of Engineering degree on a part-time or full-time basis. On entry, part-time students have a Higher National Certificate in Engineering or equivalent, and follow the same syllabuses as the full-time students. To make up for the difference in formal teaching hours, part-time students follow a program of Directed Studies which supports the lecture course. Guidance is provided on how to approach the self learning activities.

In Mathematics, some of the Directed Studies take the form of CAL programs while others are of a more traditional nature. For the CAL programs, the student is offered the option of either self-contained disks which can be used on any IBM compatible machine, or a key diskette with which to access the programs on any of the College machines.

This paper discusses advantages and disadvantages of using CAL programs for an exercise such as this, and presents an evaluation of student reaction to the different forms of Directed Studies.

BACKGROUND

The students enter this course with a wide spread of qualifications and an age range of 21 - 40. Theoretically, many of the students could be exempted from the first of three modules in year one but, at registration, they are all given a basic algebra and trigonometry test and immediately following this experience they are encouraged to study all the modules. The mathematics previously studied by the students tended to be taught as a collection of topics and, in the first year of the course, reorientation and consolidation of this work is stressed. The Directed Studies programmes in all subjects for the first 10 weeks are handed out at registration. In the first set of Directed Studies for Mathematics, one of the five used CAL packages whereas the other four involved directed reading and exercises.

The CAL programs used were written in TenCORE and contained programs prepared at Glasgow College by the CALMAT group and programs supplied by Professor L Dornhoff of University of Illinois at Urbana-Champaign. Questionniares were used to obtain information to help us organise the course in following years in the form which best suits the needs of this special group of students.

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The first of the Directed Studies covered the revision of basic algebra, and was essentially that examined in the diagnostic test given on registration day. The students had the opportunity either to take self-contained disks away with them or to use the College machines. The latter option involved them purchasing a simple key disk which would allow access to the College micros. It also contained a simple management system which recorded for each program the time spent, and a fairly crude score. It was confidently expected that, of the 80 students, perhaps 20 would take disks away with them and the rest would use the College machines. Exactly the reverse was the case.

The major problem arose later. The students had been told they needed an IBM compatible machine and colour monitor. I omitted to specify that they needed an appropriate graphics card. Hardware difficulties were a problem and some students got very disillusioned. I had estimated 5 hours would be required for this Directed Study and the average turned out to be much greater. The disks were due to be handed in two weeks later when the course had its first meeting. This Directed Study elicited very strong reactions varying from asking for more programs to be copied - "anything relevant to the course please" - to "no more CAL - it's a waste of time".

Initial analyses of the questionnaires indicate that, even after deducting the time wasted in coping with the hardware difficulties, students spent longer on the CAL Directed Studies than on any other. Certainly if time spent is related in any way to learning, CAL was successful.

Given the hardware problems experienced by the students, the first Directed Study of the next module was designed to be carried out in College on a 'spare' day before the Christmas holiday. Reaction to this - for which there were no hardware problems (except that the screen blank command did not give the slower students enough time to think!) was also very mixed. On the question of whether, given no hardware problems, the students would like more material on CAL, about half were opposed.

This particular CAL package had been used very successfully with the full time Engineering students who quickly became competent at matrix operations. This group had been given a deadline for completing the exercise and most kept to it. Engineering lecturers were pleased about how good the students were at matrices, and the student themselves commented on the discreet nature of the learning process. Despite the occasional bugs in the software, they enthusiastically asked for more CAL packages.

It could be that the full time students had a longer period of time in which to complete the package, although the actual time spent on it was no longer. The average age in the part-time class is greater, but it was the older, full-time students who were most enthusiastic. Investigations are continuing to try to understand the different reactions of these two groups.

Full analysis of the questionnaires handed out on the matrix package is not yet complete, but initial results indicate that the better students were the most enthusiastic about the programs.

SUMMARY OF QUESTIONNAIRES

Advantages perceived by the students were that they could proceed at their own pace and could obtain immediate feedback on mistakes and help when it was needed. The main complaint involved the 'progression hurdle' on some of the programs which involved the student having to get four consecutive problems correct before being allowed to proceed to the next section. This was the feature disliked most, however, it was for a small number of students the aspect of the program they liked best.

An interesting response to an open question on which aspects of the program they liked least, was that many said it took too long and they could have learned more by traditional methods, which is hard to believe. It could be that the individual programs are too long. Also a significant number felt they would have liked to have some notes to take home with them.

CONCLUSIONS

We have decided that in future:

1. We will construct shorter programs that the average student can complete in half an hour.

2. We will provide back up notes, preferably containing some screen dumps to jog the memory.

3. We will not change the progression hurdle at this point on all the programs, but we are discussing an alternative strategy of giving, perhaps five questions, and telling students how many are correct on the first attempt, and then giving them the option to take another set of 5 questions if they prefer.

The main disadvantages were hardware related and not foreseen, mainly because we expected most of the students to use College machines. The advantages are the ones usually associated with a CAL package, namely immediate feedback and help, with the student being able to control the pace. In addition, we had thought that, given their diverse backgrounds, individual students should be able to concentrate on parts of the programs in which they had weaknesses, but no student commented specifically on this. We still believe this is a valid advantage for these students.

Analysis of questionnaires is continuing to determine whether there are any relationships between the time spent on directed studies, the performance in the tests and Assessable coursework. Initial reaction to the question of whether these students learn better with

CAL than by traditional teaching methods is that some students do and some do not. Discussions are underway to see if we can determine which students benefit, and whether we should offer alternative traditional Directed Studies to those students vehemently opposed to CAL.

APPROPRIATE PROJECTS FOR TELECOMMUNICATIONS

James K. Shannon*

ABSTRACT

Since the introduction of telecommunications, business has found and continues to search for different applications that could benefit from this type of delivery system. Applications in general are not difficult to identify; however, not all applications are truly enhanced by this mode of delivery. Projects that are not enhanced are usually characterized as "just another way to do the same thing." We at AnySoft Applications were confronted with this problem during the development of our educational product "KeyRing".

INTRODUCTION

The planning phase of any new computerized project requires hundreds of hours of analyzing how, once completed, the system will be accepted in the work place. To help project the acceptance of the project most developers emphasize screen appearance, printout appearance, off line documentation, help screens, consistent function keys, speed, and most importantly accuracy of information. These concepts are generally categorized as:

1. Does the system do what it is designed to do, and
2. is the system user-friendly?

We at AnySoft Applications did indeed try to follow these guidelines when producing our educational product called "KeyRing." During the planning phases of the project we would analyze each aspect as to its degree of accuracy as well as its user friendliness. Additionally, however, for every phase of development we analyzed its 'Zero Return' element. 'Zero Return' was an in-house buzz word that meant to evaluate whether the computer was working for the user or vice versa. If the user was working for the computer, then the amount of time or effort required to enter needed data for the program to properly function exceeded the value of the end results. In essence if too much work was required to achieve the end result, then this aspect of the program was given a 'Zero Return' rating, and had to be redesigned or eliminated.

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PURPOSE

"KeyRing" is designed to provide a vehicle for 'On Site Publishing' of supplemental materials for the classroom teachers. It is designed to be a continuous growing source of integrated curricula information that would have the flexibility to allow any site, regardless of it basel textbooks, to selectively generate appropriate personalized supplemental materials. During the planning and development of this project, we held multiple sessions to analyze each program aspect. One such meeting involved addressing the best way to constantly update the user's system so that our project could be a continuously growing source of information.

Most of our original discussions centered around the following five points:

1. What is the best way to up-dating a user's existing curriculum files?
2. What is the best way to deliver new curricula?
3. How can we reduce or eliminate any additional work impact on the end user?
4. What would be the most cost effective method of delivering these materials?
5. What would be the most efficient method of delivering these materials?

Our immediate solution was to use telecommunications to solve these questions. However, during our analysis we discovered that many users' opinions of telecommunications was a 'Zero Return.' The most common use of telecommunications, electronic mail, when traveling from secretary to secretary instead of sender to receiver, actually created more paper work than sending the letter. We were then faced with either enhancing this option or eliminating this option as a possible solution.

We were convinced that telecommunications was the only solution that would allow us to market this product that was designed to continuously grow with information. Sending up-dates on diskettes would eventually lead to out of sync user systems which could cause problems too great to be listed in this paper. Secondly, marketing our product as a fixed curricula would reduce its marketability. Therefore, we had to concentrate on enhancing the telecommunication process.

SOLUTION

We began by informally surveying teachers. We asked them what they thought about their math book, or reading book, etc.. We simply were randomly picking educational materials and soliciting their opinions. We were searching for a way that we could introduce telecommunications as a service to our users, and thus enhance this program aspect. During this time it became obvious that almost all of the teachers had opinions and recommendations about the material they were working with on a daily basis.

This was the enhancement we needed to use telecommunications. We would provide the classroom teacher with a process to send messages directly to the authors of the various curricula. We would pick up and deliver the correspondence while we were updating their curriculum files. We would provide a vehicle to allow the classroom teacher to actively participate in the maintenance and growth of the system.

This early planning phase discussion allowed us to expand the scope of the project. By identifying the 'Zero Return' of telecommunications, we were then forced to alter our original use of this concept. The additional research opened the way to allow our users to participate in the project. It also gave us the insight to realize that we had the opportunity to establish a large educational network that would allow for the sharing of concepts and new ideas. To date our users have submitted suggestions, not only in the content of curriculum but also in the system's presentation of the material. Their input into our system has allowed our system to expand to meet the needs of a larger user base.

USING THE COMPUTER TO DEVELOP AND IMPROVE WRITING SKILLS

Walter Smith

ABSTRACT

Developing better writing skills has become a major objective for many school districts. A relatively new computer software program, Wordmap1, addresses the problems of developing and improving writing skills. Wordmap1 checks students' themes for correct grammatical usage, style, punctuation and spelling. It saves time for the teacher and gives students immediate feedback about errors. Students use the computer to make changes in the themes and since they get the papers back sooner and since they can make changes faster, they can write more often. Both teachers and students benefit from the use of Wordmap1 Grammar Analysis.

Is there a problem with the writing programs in the schools?

Everyone is concerned about the student's inability to write correctly. In recent years many articles have been written about students not being able to pass writing tests at a minimum level. Several states require students to pass writing tests before they can graduate from high school, or receive a high school diploma.

Students must be able to write often and learn ways to correct mistakes and/or improve the grammatical usage in their papers. Most students don't get the opportunity to write a paper in class more than once a week and often the papers are not analyzed and returned during the same week. This means that the students do not have the opportunity to study or correct the errors while the objectives of the papers were fresh in the minds of the students.

Why don't students get to write more often?

The average student class load per day for the English teacher is 150 to 160, which makes it impossible to check more than one 300-500 word paper each week for each student. It is difficult for the teacher to keep a record of the specific types of mistakes made by each student and the whole class, when checking the paper manually. Also, the student must rewrite the theme by hand, which is laborious and time consuming.

It is essential that methods be used to relieve the teacher and student of the monotonous, laborious and time-consuming tasks of writing papers, making changes on the paper, checking or analyzing the papers for correct grammar usage, spelling, punctuation and style. The teacher needs to be freed to prepare for instruction and analyze the papers for content and creativity.

How can the computer be used to develop and improve writing skills?

With the advent of the computer and wordprocessing software came the wonderful opportunity for teachers to have students use the computer to enter their themes. Wordprocessing software has made it possible for students to submit papers that have quality appearance and the words checked for spelling. The preceding innovations provided the base for improving students' writing skills, but the major software components, grammar analysis, punctuation checks, and style checks, were not available until recently.

Dr. Eldon Lytle recognized the vacuum and set out to develop a software program that would help students to improve writing skills. This new program was given the label "Wordmap I Grammar and Spelling Analysis". Wordmap I Grammar Analysis software was tested in grades 6-12 at Panaca, Nevada. After the software was tested and refined, it was introduced to the educational world in 1986.

How is Wordmap I used?

The teacher helps students to learn the grammar usage rules and understand how to apply them when writing. Students are given writing assignments and enter the documents on computers. The documents are transferred to a host computer where the Wordmap I software is housed. The person operating the writing or computer laboratory gives a command for the documents to be analyzed and graphs printed to show the types and number of errors identified in each paper. The computer analyzes the students' papers and the printer types a printout for each student's paper. A printout with every error flagged by brackets or bold print is returned to the student. If the school has a computer network, the document with the flagged errors are sent back to the students' monitors rather than being printed out. The students study the errors that have been flagged and make decisions about how to correct them. The changes are made on the monitor through the use of wordprocessing. A revised copy of the document is resubmitted to the host computer to be reanalyzed.

How does Wordmap1 assist the teacher?

Firstly, it saves considerable time for the teacher because it checks the students' papers for spelling, punctuation, grammatical usage and style.

Secondly, the software gives the teacher a graph for each student. The graph shows the number of errors that were identified for each area checked by the computer. The areas are listed in following paragraphs. After studying the graphs, the teacher can determine areas where additional instruction needs to be provided to the students, such as subject-verb agreement, fragments, etc. When the teacher checks papers without the aid of the computer, it is impossible to determine the number of mistakes made in each area by each student. Wordmap I makes it possible!

Thirdly, Wordmap I and the computer make it possible for the teacher to check the papers overnight or sooner and return the papers to the students with the errors identified.

For what does Wordmap I check?

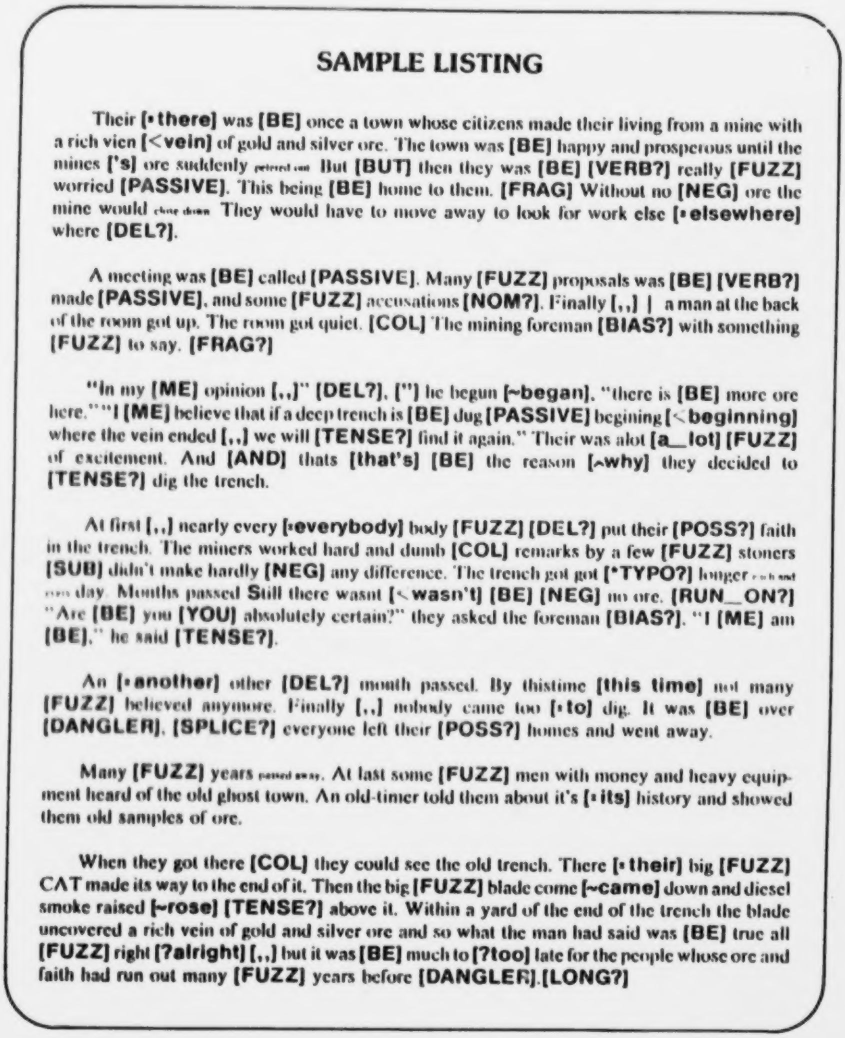
- Spelling
- Apostrophes
- Contractions
- Homonyms
- Punctuation
- Capitalization
- Sentence Problems
    - Fragment
    - Splice
    - Run-On
    - Initial And/But
    - THAT Omission
    - Serial If/Because
    - Long Sentence
- Tense Shift
- Verb Agreement
- Pronoun Agreement
- Double Comparison
- Double Negative
- Split Infinitive
- Dangling Preposition
- Redundancy
- Elements of Style
    - Nominalizations
    - 1st Person (ME)
    - 2nd Person (YOU)
    - BE Verbs
    - Passives

General Usage
    Fuzzy Words
    Cliches
    Idioms
    Slang
    Colloquialisms
    Profanity
    Bias

Noun-Noun Combos
Word Counts
Each Paragraph
Aver Per Paragraph
Total Words
Parts Of Speech
(Optional)

Computer Scores
    By Item
    By Type

How does a theme appear after it has been analyzed by Wordmap I software?



SAMPLE LISTING

Their **[•there]** was **[BE]** once a town whose citizens made their living from a mine with a rich vien **[<vein]** of gold and silver ore. The town was **[BE]** happy and prosperous until the mines **['s]** ore suddenly petered out But **[BUT]** then they was **[BE]** **[VERB?]** really **[FUZZ]** worried **[PASSIVE]**. This being **[BE]** home to them. **[FRAG]** Without no **[NEG]** ore the mine would close down They would have to move away to look for work else **[•elsewhere]** where **[DEL?]**.

A meeting was **[BE]** called **[PASSIVE]**. Many **[FUZZ]** proposals was **[BE]** **[VERB?]** made **[PASSIVE]**, and some **[FUZZ]** accusations **[NOM?]**. Finally **[,,]** | a man at the back of the room got up. The room got quiet. **[COL]** The mining foreman **[BIAS?]** with something **[FUZZ]** to say. **[FRAG?]**

"In my **[ME]** opinion **[,,]**" **[DEL?]**, **["]** he begun **[~began]**. "there is **[BE]** more ore here." "I **[ME]** believe that if a deep trench is **[BE]** dug **[PASSIVE]** begining **[<beginning]** where the vein ended **[,,]** we will **[TENSE?]** find it again." Their was alot **[a_lot]** **[FUZZ]** of excitement. And **[AND]** thats **[that's]** **[BE]** the reason **[~why]** they decided to **[TENSE?]** dig the trench.

At first **[,,]** nearly every **[•everybody]** body **[FUZZ]** **[DEL?]** put their **[POSS?]** faith in the trench. The miners worked hard and dumb **[COL]** remarks by a few **[FUZZ]** stoners **[SUB]** didn't make hardly **[NEG]** any difference. The trench got got **[*TYPO?]** longer each and every day. Months passed Still there wasnt **[<wasn't]** **[BE]** **[NEG]** no ore. **[RUN_ON?]** "Are **[BE]** you **[YOU]** absolutely certain?" they asked the foreman **[BIAS?]**. "I **[ME]** am **[BE]**," he said **[TENSE?]**.

An **[•another]** other **[DEL?]** month passed. By thistime **[this time]** not many **[FUZZ]** believed anymore. Finally **[,,]** nobody came too **[•to]** dig. It was **[BE]** over **[DANGLER]**. **[SPLICE?]** everyone left their **[POSS?]** homes and went away.

Many **[FUZZ]** years passed away. At last some **[FUZZ]** men with money and heavy equipment heard of the old ghost town. An old-timer told them about it's **[•its]** history and showed them old samples of ore.

When they got there **[COL]** they could see the old trench. There **[•their]** big **[FUZZ]** CAT made its way to the end of it. Then the big **[FUZZ]** blade come **[~came]** down and diesel smoke raised **[~rose]** **[TENSE?]** above it. Within a yard of the end of the trench the blade uncovered a rich vein of gold and silver ore and so what the man had said was **[BE]** true all **[FUZZ]** right **[?alright]** **[,,]** but it was **[BE]** much to **[?too]** late for the people whose ore and faith had run out many **[FUZZ]** years before **[DANGLER]**.**[LONG?]**